OCTOBER · 1952
PRICE 75 CENTS

electronics

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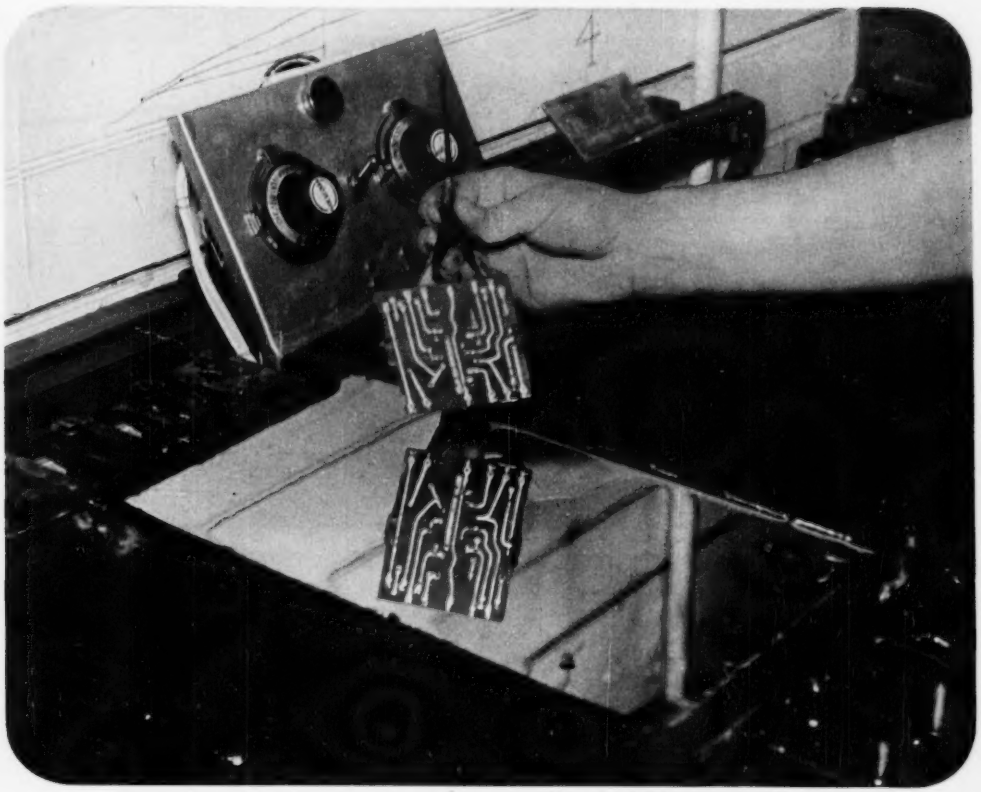
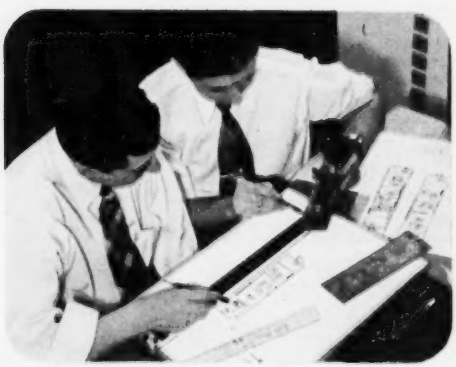


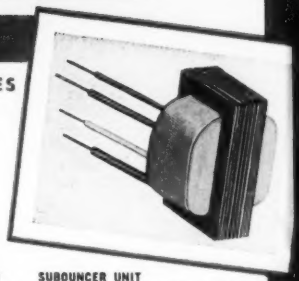
Printed Circuit Techniques



MINIATURE COMPONENTS FROM STOCK...

SUBOUNCER UNITS

FOR HEARING AIDS...VEST POCKET RADIOS...MIDGET DEVICES



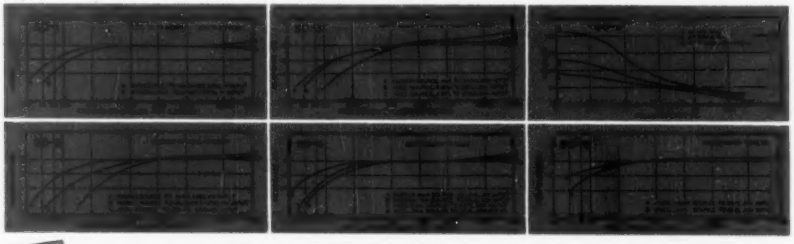
UTC Sub-Ouncer units fulfill an essential requirement for miniaturized components having relatively high efficiency and wide frequency response. Through the use of special nickel iron core materials and winding methods, these miniature units have performance and dependability characteristics far superior to any other comparable items. They are ideal for hearing aids, miniature radios, and other types of miniature electronic equipment.

The coils employ automatic layer windings of double Formex wire... in a molded Nylon bobbin. All insulation is of cellulose acetate. Four inch color coded flexible leads are employed, securely anchored mechanically. No mounting facilities are provided, since this would preclude maximum flexibility in location. Units are vacuum impregnated and double (water proof) sealed. The curves below indicate the excellent frequency response available. Alternate curves are shown to indicate operating characteristics in various typical applications.

Type	Application	Level	Pri. Imp.	D.C in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.	List Price
*S0-1	Input	+ 4 V U	200 50	0	250,000 62,500	16	2650	$6.50
S0-2	Interstage/3:1	+ 4 V.U	10,000	0	90,000	225	1850	6.50
*S0-3	Plate to Line	+ 20 V U	10,000 25,000	3 mil 1.5 mil.	200 500	1300	30	6.50
S0-4	Output	+ 20 V U	30,000	1.0 mil	50	1800	4.3	6.50
S0-5	Reactor 50 HY at 1 mil D.C. 3000 ohms D.C. Res							5.50
S0-6	Output	+ 20 V U	100,000	.5 mil.	60	3250	3.8	6.50

*Impedance ratio is fixed, 1250:1 for S0-1, 1:50 for S0-3 Any impedance between the values shown may be employed

SUBOUNCER UNIT
Dimensions....9/16" x 5/8" x 7/8"
Weight.....03 lb.



SUB-SUBOUNCER UNITS

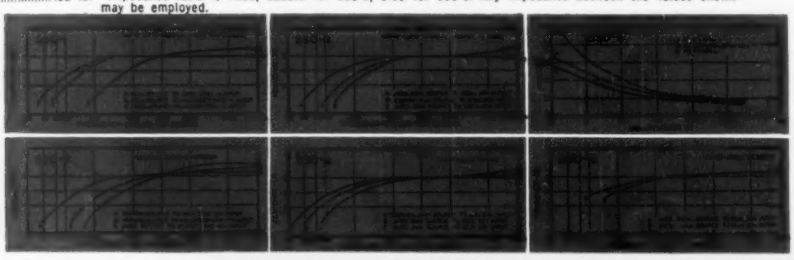
FOR HEARING AIDS AND ULTRA-MINIATURE EQUIPMENT

UTC Sub-SubOuncer units have exceptionally high efficiency and frequency range in their ultra-miniature size. This has been effected through the use of specially selected Hiperm-Alloy core material and special winding methods. The constructional details are identical to those of the Sub-Ouncer units described above. The curves below show actual characteristics under typical conditions of application.

Type	Application	Level	Pri. Imp.	D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.	List Price
*SS0-1	Input	+ 4 V.U	200 50	0	250,000 62,500	13.5	3700	$6.50
SS0-2	Interstage/3:1	+ 4 V.U.	10,000	0	90,000	750	3250	6.50
*SS0-3	Plate to Line	+ 20 V U	10,000 25,000	3 mil. 1.5 mil.	200 500	2600	35	6.50
SS0-4	Output	+ 20 V U	30,000	1.0 mil.	50	2875	4.6	6.50
SS0-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.							5.50
SS0-6	Ouptut	+ 20 V.U.	100,000	.5 mil.	60	4700	3.3	6.50

*Impedance ratio is fixed, 1250:1 for SS0-1, 1:50 for SS0-3. Any impedance between the values shown may be employed.

SUB-SUBOUNCER UNIT
Dimensions....7/16" x 3/4" x 5/8"
Weight.....02 lb.



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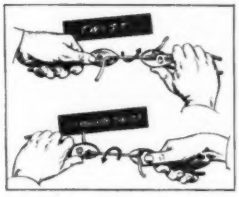

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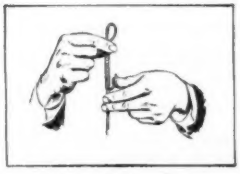

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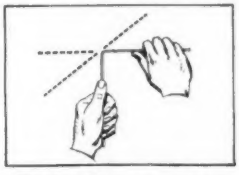

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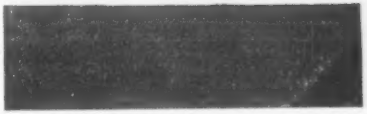

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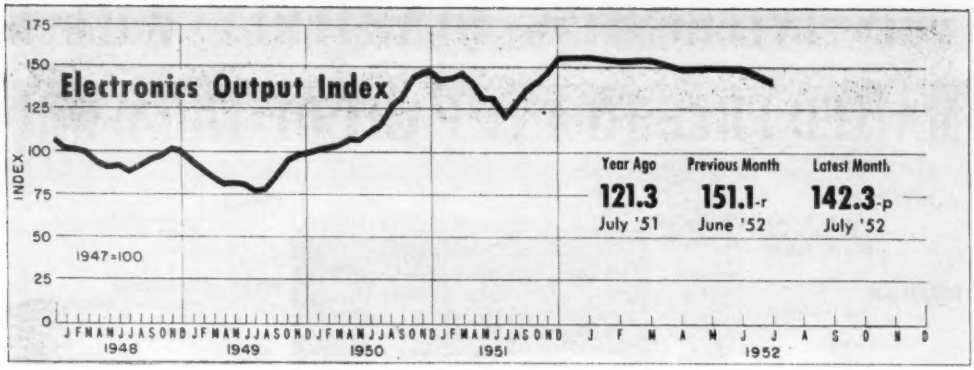


FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)

	Year Ago	Previous Month	Latest Month
	July '51	June '52	July '52
Television sets	152,306	361,152	198,921-p
Home Radio sets	184,002	422,158	265,163-p
Portable sets	70,538	205,186	81,353-p
Auto sets	293,955	246,909	95,220-p

RECEIVER SALES

(Source: Licensee figures)

	Apr. '51	Mar. '52	Apr. '52
Television sets, units	285,498	370,905	349,015
Electric radio sets, units	485,970	380,846	354,518
Battery sets, units	136,981	68,339	82,873
Auto sets, units	1,057,484	204,990	235,651
Television sets, value	$49,061,450	$62,988,663	$58,872,294
Electric radio sets, value	$11,222,433	$7,963,825	$8,594,861
Battery sets, value	$2,592,267	$1,332,640	$1,495,919
Auto sets, value	$26,076,566	$5,912,217	$6,700,718

RECEIVING TUBE SALES

(Source: RTMA)

	July '51	June '52	July '52
Receiv. tubes, total units	13,185,567	24,365,462	20,944,831
Receiving tubes, new sets	7,117,435	15,770,335	11,504,503
Rec. tubes, replacement	4,625,314	5,187,557	6,795,252
Receiving tubes, gov't.	220,083	2,477,569	1,956,905
Receiving tubes, export	1,222,735	930,001	688,171
Picture tubes, to mfrs.	89,144	285,975	239,625

BROADCAST STATIONS

(Source: FCC)

	Aug. '51	July '52	Aug. '52
TV Stations on Air	107	109	109
TV Stns CPs—not on air	1	21	34
TV Stns—Applications	440	838	855
AM Stations on Air	2,292	2,356	2,356
AM Stns CPs—not on air	105	95	112
AM Stns—Applications	278	300	291
FM Stations on Air	645	627	622
FM Stns CPs—not on air	11	18	21
FM Stns—Applications	8	12	12

NETWORK BILLINGS

(Source: Pub. Info. Bureau)

	July '51	June '52	July '52
AM/FM—ABC	$2,267,674	$3,001,314	$2,082,666
AM/FM—CBS	$4,387,193	$4,590,536	$3,238,256
AM/FM—MBS	$1,347,841	$1,632,977	$1,339,276
AM/FM—NBC	$3,728,687	$3,708,014	$2,878,196
TV—ABC	$1,351,168	$1,276,250	$943,387
TV—CBS	$3,434,659	$5,385,820	$4,163,245
TV—DuMont	$645,359	$758,356	$653,415
TV—NBC	$3,477,952	$5,904,546	$4,591,130

TV AUDIENCE

(Source: NBC Research Dept.)

	Aug. '51	July '52	Aug. '52
Sets in Use—total	13,271,700	17,983,200	18,354,300
Sets in Use—netw'k conn.	11,205,500	17,955,000	18,325,700
Sets in Use—New York	2,455,000	3,040,000	3,070,000
Sets in Use—Los Angeles	1,003,000	1,215,000	1,230,000
Sets in Use—Chicago	942,000	1,185,000	1,210,000

COMMUNICATION AUTHORIZATIONS

(Source: FCC)

	June '51	May '52	June '52
Aeronautical	34,061	32,852	32,603
Marine	29,544	35,476	35,500
Police, fire, etc.	9,129	10,965	11,143
Industrial	9,551	13,056	13,680
Land Transportation	4,253	4,966	5,027
Amateur	90,585	110,931	113,092
Citizens Radio	560	1,175	1,401
Disaster	2	65	71
Experimental	475	357	488
Common carrier	815	970	985

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)

	June '51	May '52	June '52
Prod. workers, electronic	241,200	267,000-r	266,800-p
Prod. wkrs., radio, etc.	149,000	167,200	166,100-p
Av. wkly. earnings, elect.	$62.05	$64.80-r	$64.48-p
Av. wkly. earnings, radio	$58.42	$60.83-r	$60.77-p
Av. weekly hours, elect.	41.2	40.6	40.3-p
Av. weekly hours, radio	40.4	40.1	39.8-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)

	Aug. '51	July '52	Aug. '52
Radio—TV & Electronics	242.9	295.7	291.1
Radio Broadcasters	230.6	282.4	279.6

INDUSTRIAL EQUIPMENT ORDERS

(Source: NEMA)

	Quarterly Figures		
	Year Ago	Previous Quarter	Latest Quarter
	2nd '51	1st '52	2nd '52
Dielectric Heating	$600,000	$150,000	$510,000
Induction Heating	$3,140,000	$2,400,000	$2,410,000

INDUSTRIAL TUBE SALES

(Source: NEMA)

	2nd '51	1st '52	2nd '52
Vacuum (non-receiving)	$7,750,000	$11,320,000	$12,110,000
Gas or vapor	$2,700,000	$3,100,000	$3,150,000
Phototubes	$360,000	$500,000	$480,000
Magnetrons and velocity modulation tubes	$4,130,000	$8,460,000	$9,830,000

p—provisional; r—revised; e—estimated

INDUSTRY REPORT

Army Spurs Transistor Production

Four recent contract awards totaling $5,377,960 are aimed at machinery development

WITH the awarding of four large contracts (Raytheon $1,180,053, General Electric $1,364,674, Sylvania $1,599,200 and RCA $1,234,033), the Signal Corps has started the ball rolling on increased production of point-contact and junction transistors and germanium diodes.

These contracts have not been awarded for large quantities of transistors but rather for setting up operations, developing automatic production machinery and for running off sample lots.

Pilot production runs with the machinery developed will be used to prove out and perfect designs, machines and techniques leading to final approval of the transistors. Standardization for size and test procedures will also result.

▶ **Machinery Requirements**—Automatic machinery is to be designed to perform the following basic operations or functions: purify germanium, grow crystals, cut and prepare pellets, mount and clean pellets, etch pellets, form junctions, form cat whiskers, assemble and test point contacts, package and test electrically.

The machinery is to be capable of producing 5,000 units each of point-contact transistor, junction transistors and diodes per week and will remain Signal Corps property once developed.

▶ **Transistor Types**—Point-contact transistors involved in these contracts are for general purpose and switching applications. Junction transistors are for low-power general-purpose use and for high-power applications (½ watt to 100 watts) at audio frequencies. Junction-type phototransistors are also included. Diodes are to be of the point-contact type and junction type for power rectification at low and high currents.

New ASDE Radar At Idlewild Airport

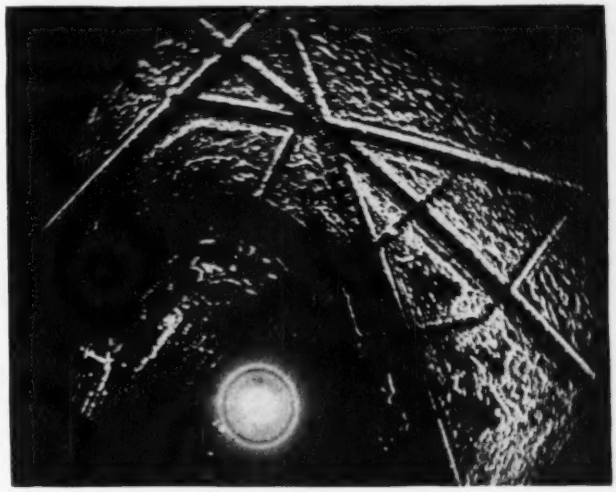
High-resolution set guides ground traffic in instrument weather

ON THE 16th of September a new eleven-story CAA control tower at New York's Idlewild International Airport went into operation, using something new in the way of electronic control equipment.

In the control room a prominent position has been given to the new ASDE (Airport Surface Detection Equipment) radar. This equipment has received the popular name "taxi" radar, since it is used in guiding aircraft after landing and before takeoff during weather when planes cannot be seen visually by the tower operators.

The new high-resolution radar was developed for the USAF Rome Air Development Center and has been installed at Idlewild for CAA evaluation under high-traffic-density conditions. Through its use, experienced operators can follow an aircraft from touchdown and guide it safely by radio to appropriate taxi strips and to unloading platforms.

▶ **Grass**—In dealing with the high-resolution ground surveillance equipment, engineers have found it



Airport surface radar clearly shows outline of planes, buildings, runways and taxi strips. Note multiple image of plane made during landing by time exposure of successive 60 per minute sweeps

necessary to use qualifying words in speaking of grass. When referring to radar grass (noise), one uses the two words "radar grass" to avoid confusion with "green grass" (that which grows on the ground) which shows up clearly on the 16-inch radar scope.

An experienced operator can distinguish between 2 and 4-engine airplanes by their returns.

Research on the project was begun at Gilfillan and final development work was carried on at Airborne Instruments Laboratories. It is believed that the new type radar will speed up traffic in large air terminals during instrument weather by providing airport operators with a positive means for controlling ground traffic.

UHF Egg Is Waiting for UHF Chicken

Receiver manufacturers working fast to ready sets for coming markets

"I DO NOT WISH to seem bureaucratic," said Federal Communications Commissioner Rosel H. Hyde recently, "but I feel strongly that every purchaser of a new tv set is entitled to a set providing complete tv service. And a set which is not designed for uhf reception does not offer complete tv service." What his West Coast audience of radio engineers and electronic manufacturers thought in reply is not recorded.

▶**Three Questions**—Engineers and set manufacturers face three general technical problems—what basic circuits to put in a uhf set; whether to use strip or continuous tuning; how much of the whole uhf-vhf receiving package they should consider.

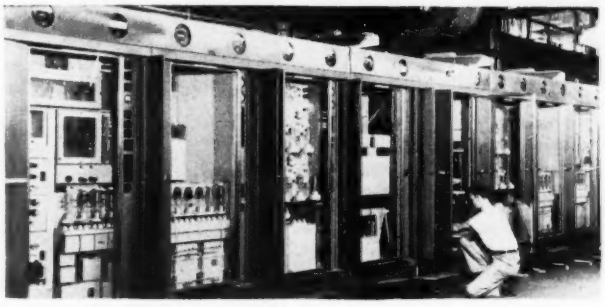
Engineers know how to build uhf receivers or adapters. But to market a receiver that appeals to the general public requires compromise with optimum engineering design. As a result, production men to whom ELECTRONICS has talked think that the initial large production can be expected to comprise converter-type circuits, either built into the console or in separate boxes with a uhf oscillator beating the signal down to vhf around channel 5 or 6. Suitable oscillator tubes seem to be available, but it is a safe bet that germanium or silicon crystal mixers will be used for some time. Many designers think radio-frequency amplifiers either have discouraging noise figures or cost too much. Intermediate frequencies will be 40 mc and noise figures may run between 15 and 22 db. (Good vhf sets may be as low as 10 db.)

Will most people buy sets having switches for quick tuning? Or will they prefer continuous tuners that may be slightly less convenient to use, but insure complete coverage of all uhf television channels? The answer may well reside in the attitude of dealers out of whose time, and perhaps profits, will come the changing of strips. Manufacturers haven't made up their minds just how this problem will finally work out but they tell us that they will not be caught napping.

Some set manufacturers, like the people who make tubes, transmission lines and antennas, feel that their own problems are a big enough worry. They are content to turn out their respective products and let the serviceman put the pieces together. Others take a lively interest in the whole receiving package from the roof down. While they may not manufacture the various critical components they are in active co-operation with those who do.

▶**Outside the House**—Antennas (p 5, Sept. 1952) seem to present no great problem, although installers may quickly find that no one design is the answer for every location at every frequency. Inexpensive low-loss transmission line to connect antenna and set just ain't! Line available now has losses ranging upwards from 5 db per 100 feet at 1,000 mc when dry. Tested under water the losses rise fantastically. Fortunately, there will be few uhf-tv installations as damp as this. It is known that new lines have been developed and ordered in quantity. Other, better, lines are in development. But the developers won't let their names be mentioned.

New York's Ch. 9 Gets Power Boost



New vhf 20-kw television transmitter on test. Final amplifier for WOR-TV comprises four-units of this lineup

NEW YORK CITY'S lone standout tv station, located across the river in Jersey rather than on the Empire State tower, is due to jump its erp (effective radiated power) from 22,000 to 90,000 watts in late September. At this time, fringe-area regions will start getting better signals and Grade A coverage will increase from a present radius of 30 miles to about 39.5 miles. The Grade B region will expand its present 50-mile radius to approximately 57 miles.

While this leaves some margin

(Continued on page 8)

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below the FCC legal maximum, WOR-TV engineers are satisfied to take a long look at what now passes for real high power at vhf before they reach for the ceiling.

▶**First of a Line**—WOR-TV's Decision to use Standard Electronics Corp. equipment is a minor triumph for this Claude Neon, Inc. subsidiary. The company inherited the Western Electric line of a-m and f-m transmitters some time ago. The tv transmitter line, however, is pure Standard, whose engineers have been working hard over its development for more than two years.

Nub of the high-power amplifier is the Amperex type AX9904R/5924 forced-air-cooled triode. With a manufacturer's upper limit of 220 mc, this tube should be good even at channel 13 (210-216 mc).

Broadcast Phase of CONELRAD Approved by Co-op Agencies

CD officials urge production of $8 battery-or-line receiver and repair campaign

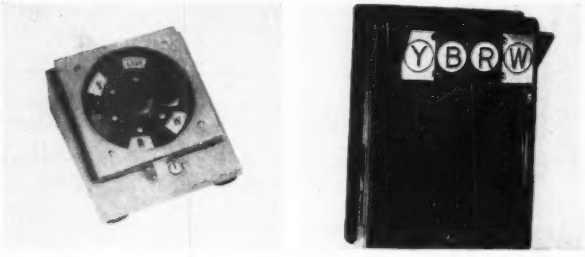
OPERATION CONELRAD (control of electromagnetic radiation) is essentially a broad-gage plan to furnish limited broadcast radio service to the general public while denying navigation information to enemy aircraft (ELECTRONICS, p 94, Aug. 1952).

Implementation of the broadcast (a-m, f-m, tv) phase involves more than 1,200 a-m stations grouped in 200 clusters throughout the country. Most of the technical bugs have been ironed out and the plan approved by FCDA, FCC, Air Force, Air Defense Command, Secretary of Defense and National Securities Resources Board.

▶**Who Pays**—Air Force has agreed to foot the $400,000 bill for control telephone lines that will be installed by the Bell System. Program lines to carry identical material to all stations of a cluster will cost $80,200, to be paid by FCDA. Broadcasters have already sunk a million and a half dollars of their own into emergency-operation equipment. They still have to buy more new crystal-control and power-varying equipment.

▶**Listener's Job**—During an emergency, all the listener has to do is tune to 640 or 1,240 kc and follow directions.

Federal Civil Defense officials are talking up a program of keeping receivers in good condition, especially battery-operated types that can be carried into shelters. Manufacturers are considering a suggestion that they develop a "cheap, portable a-m set that could sell for seven to eight dollars, operating with power or battery."



Bell System wire alerting network proposed for hospitals, factories and other large centers. Alerts and clear signals are sent from defense control point by special dial impulse to light appropriate indicator. Dial shown is under glass cover locked with key to prevent unauthorized tampering

TV Station CP Holders Look Ahead

Estimates of first year's revenue, construction and operating costs vary widely

INTRIGUING picture of the tv broadcasting business is revealed in an analysis of the first-year cost and profit estimates made by tv station applicants who now hold construction permits.

The first 49 cp grantees expect to spend a total of $15,717,624 on station construction. Thus new cp holders expect to spend an average of $350,000.

This is considerably higher than recent FCC estimates of the average investments of present tv stations in markets of comparable size.

The range in construction cost estimates swings from a low of $138,800 expected by the Appalachian Company of Scranton, Pa. using channel 73, to a high of $972,000 (nearly $300,000 higher than that of any other grantee) for the Vindicator Printing Company in Youngstown, Ohio, also granted channel 73.

▶**Profit and Loss**—First-year operating cost and revenue estimates of 41 commercial cp holders show that more than half of them expect to go in the red.

Vindicator Printing Company sees the greatest loss. They estimate first-year operating costs at $446,104 and revenue at $315,000 for a first-year loss of over $131,000.

On the other side of the ledger, Empire coil expects its station in Portland, Oregon, due in November, to show a profit. They estimate operating costs at $450,000, but expect revenue to total $525,000 for a net of $75,000.

KFEL-TV, pioneer on-the-air station of the new cp holders, estimates its first year in Denver at $520,000 for operating costs, but revenue is only expected to total $500,000 for a loss of $20,000. However, it is possible that KFEL's early estimates will need revision

(Continued on page 10)

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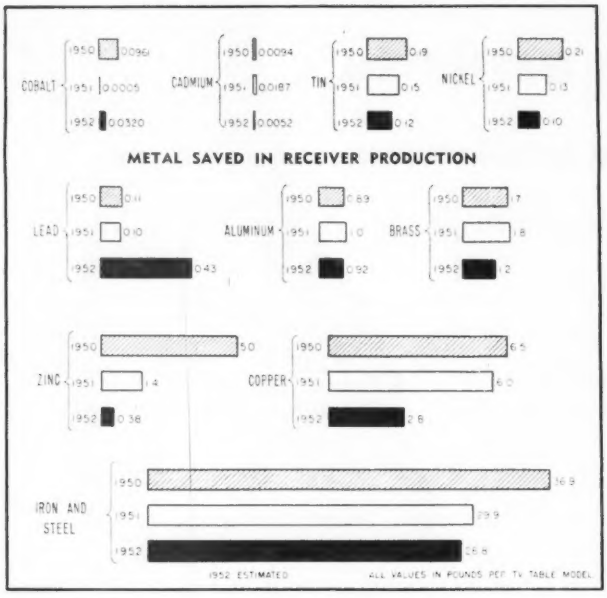
after the tv set sales boom that Denver experienced. Already the tv audience is larger than expected, so that rates can be raised to increase total revenue and reduce loss.



METAL USAGE in table model and console sets declines as . . .

Manufacturers Conserve Materials

Early estimates of savings may have to be revised but gains will still be substantial

IF the 1952 radio and television production estimate made by the RTMA Material Bureau Advisory Council earlier this year holds true, the industry will effect a 50 percent saving in the use of critical metals. (In its final report on materials used by radio and television manufacturers, the council estimates that total radio-tv production for 1952 will be 14,267,000 units compared to 18,012,160 for last year and 22,053,700 units in 1950.)

► **Outlook**—With new television markets already becoming a reality, it is probable that early 1952 production estimates, especially for tv sets, will have to be revised upwards and that total critical metal savings will not be quite as substantial as indicated. But manufacturers do not expect that the current sales upswing will drastically affect conservation.

The supply of many critical metals has improved steadily, so that some are no longer listed as critical. Copper and aluminum were recently dropped from the list and are now classified by the DPA as "supplies in approximate balance with demand."

► **Total Savings**—The following table gives a comparison of the total amounts of metals used in 1950 and likely to be used in 1952 in radio-tv production if early production estimates hold:

	1950 (tons)	1952 (tons)	% Saved
Aluminum	6,229	3,139	50
Brass	13,361	4,844	64
Cadmium	284	119	59
Cobalt	629	218	66
Copper*	40,487	12,951	69
Lead	1,154	1,790	—
Nickel	1,278	450	65
Iron, Steel	224,115	118,915	47
Tin	1,064	534	50
Zinc**	15,631	5,745	51

* Includes copper used in brass
** Includes zinc used in brass

Savings of over 47 percent are expected for every critical metal this year except lead, which has increased in use since 1950 as a result of greater use in solder.

Microwave Sharpens Europe's Air Defenses

Relay network carries radar intercept data and top-level orders

FREE EUROPE'S air defenses are now being sharpened and toughened by a million-dollar microwave radio-relay network providing highly-mobile multichannel communications, free from jamming and interference, for top-priority operational voice and telegraph circuits.

Ordered by Allied Air Forces, Central Europe, from RCA International, the system will consist of 6 terminals and 17 repeater stations plus complete standby equipment and spares. Two terminals and one repeater were in operation this month during Operation Blue Alliance as 1,500 aircraft of seven NATO countries mock-clashed in Western Europe's skies and flew close cover for British and French armies maneuvering on the Rhine.

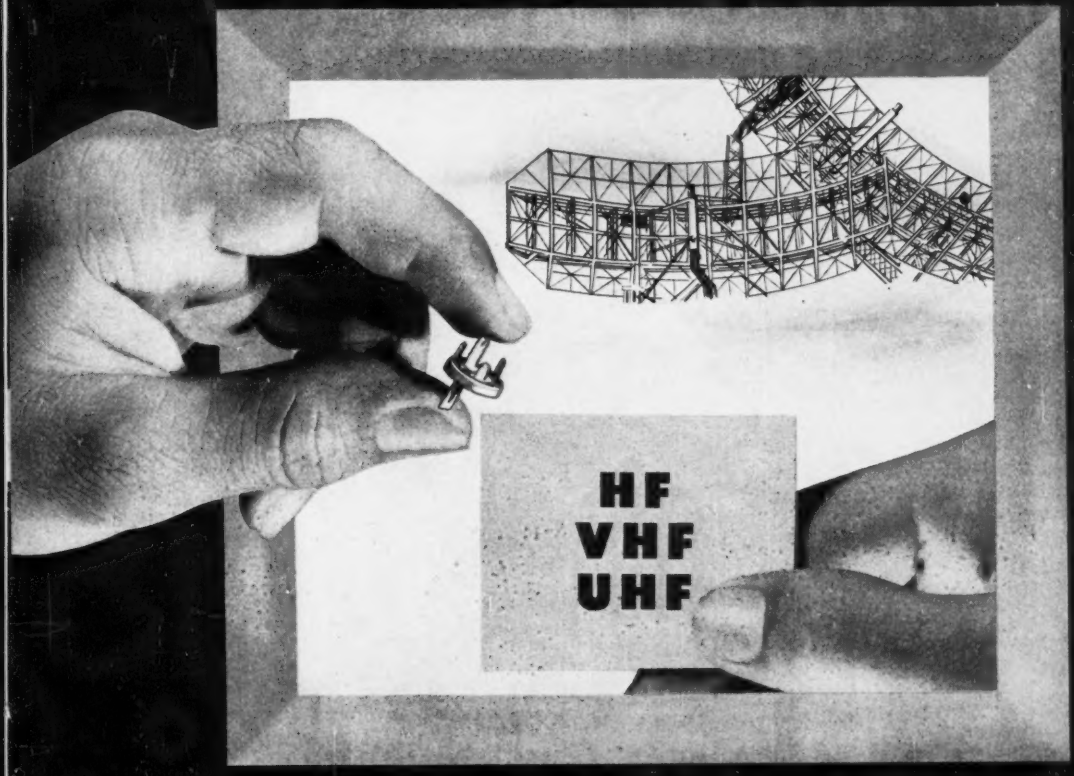
► **Mobility** – Initially installed to link major allied air installations with NATO headquarters, the equipment is readily transportable and will be moved around in the AAFCE area as required. The 58-ft. three-section telescoping masts can be collapsed to a mere 23 feet.

Each station is installed in five trucks carrying tower and antenna, cables and accessories, receiving and transmitting equipment, power generating equipment and personnel. The six-foot paraboloidal antennas, used both for transmitting and receiving, are fed with flexible RG-17/U coaxial cable.

► **System Layout**–The 15-centimeter carrier is modulated by a Lenkurt

(Continued on page 14)

Put this Ceramic Button-type Capacitor in your electronic picture...



and get 4 big exclusive advantages

for proof...see next two pages

CRL Ceramic Button-type Capacitors you get small size... longer life...

TYPE 902
FEED-THRU — with threaded shell

TYPE 903
STAND-OFF with single soldering lug

TYPE 904
STAND-OFF with tapped base-single lug

TYPE 905 and TYPE 906
FEED-THRU (LEFT) with mounting lugs (RIGHT) plain with two soldering lugs

BUTTON STYLE CERAMIC CAPACITORS are available in five different types, including feed-through with threaded shell, stand-off with soldering lug and ground terminal, and stand-off with tapped ground terminal. Used on HF, VHF, and UHF, they are especially suited for feed-through and by-pass. The shell is effectively at ground potential in all styles. Capacities range from 5 to 1000 mmf. Voltage ratings, 500 vdcw and 1000 vdct. For complete details, write for Bulletin 42-122R.

replace old-fashioned "micas"... lower inductance...lower cost!

YES, only Centralab offers these four big reasons for specifying Ceramic Button-type Capacitors for use in low power, high frequency electronic equipment. Their ceramic construction provides: (1) Small size and light weight, (2) lower cost, (3) lower inductance—a real advantage in high frequency work, (4) longer life — *there's no deterioration with age.*

These capacitors are adaptable for transmitter exciter units and communication receivers and for aircraft, marine and government equipment.

Ceramic X, the exclusive CRL dielectric, is used for the ceramic body. It's non-hygroscopic, providing the ultimate in humidity resistance. All units withstand moisture conditions as specified in Jan C-20-A.

In addition, CRL Button-type Capacitors are solder-bonded to provide maximum sealing between shell and disc. Pressure contacts are eliminated, removing the possibility of intermittance and mechanical flutter.

Compare these dependable Centralab Ceramic Button-type Capacitors with old-fashioned micas. You'll find their exclusive features are your assurance of highest quality performance and true permanence at lower cost.

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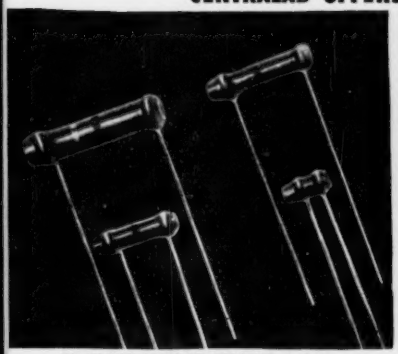
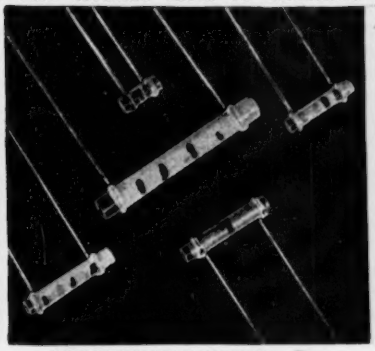
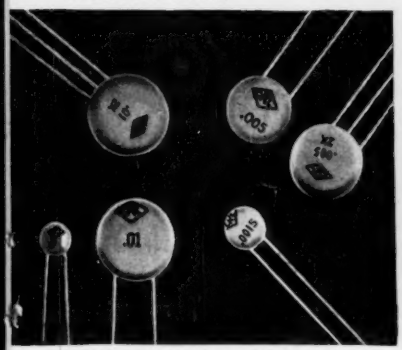


BC HI-KAP TUBULAR CERAMIC CAPACITORS available from 1 mmf to 10,000 mmf. Ideal for use in r.f. by-pass and audio-coupling applications. For details, write for Bulletin 42-3R.

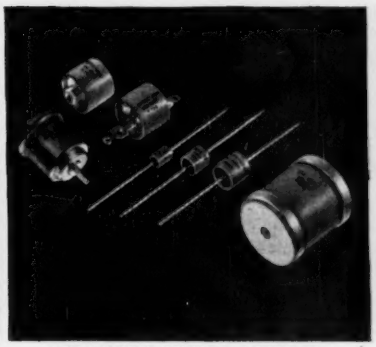


TUBULAR CERAMIC CAPACITORS — Type TCZ show no capacitance change over wide temperature range. Type TCN special ceramic body varies capacitance with temperature. Write for Bulletin 42-18.

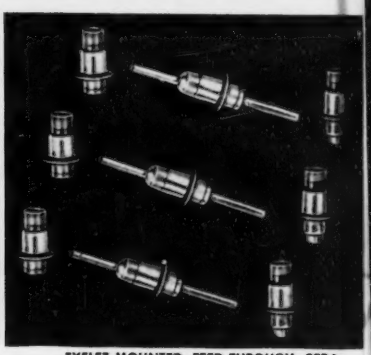
TV HI-VO-KAPS are the standard high-voltage capacitors for the TV industry. Capacitance: 500 mmf, 10 KV, 20 KV and 30 KV D. C. working. Write for 42-10R.



CERAMIC DISC HI-KAP CAPACITORS hold thickness to a minimum. Make possible very high capacity in extremely small size. Used in HF by-pass and coupling. For details, write for Bulletin 42-4R.



HIGH VOLTAGE CERAMIC CAPACITORS. Capacitance: 5 to 500 mmf, 5KV to 40 KV D.C. working. Ideal for portable or mobile equipment and high-voltage, high-frequency gear. Bulletin 42-102R.



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frequency-division system to obtain 24, 5-kc voice channels in the 10 to 135-kc modulation spectrum. Each voice channel transmits frequencies from 300 to 3,400 cps. Twenty-three channels are used for telephone circuits while the remaining voice channel is subdivided to give 16 channels of on-off keyed tone telegraph.

Encompassing about 660 route miles, the microwave network is laid out in several legs converging on Allied Air Headquarters at Fontainebleau and connecting to their major subordinate commands on the Western European continent.

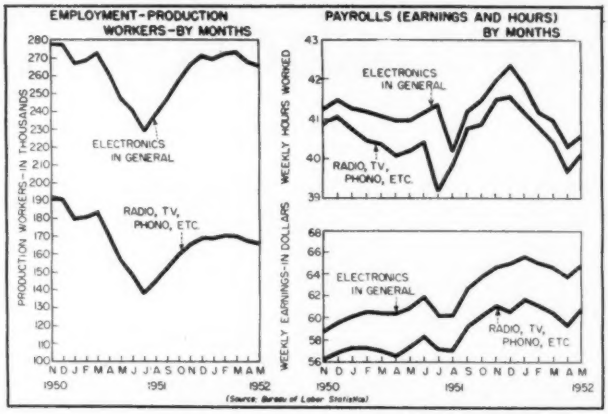
The primary network includes the 6 terminals and 17 repeaters. All 24 voice channels are available at each terminal and five voice channels are brought out for drop and insert at each repeater station. The voice channel carrying the telegraph circuits is available for drop and insert at every repeater. There is also a voice channel available below 10 kc on a party-line basis for order wire service.

A 40-mc carrier shift between transmit and receive frequencies is introduced at each relay station and terminal. Crosstalk, in addition to being reduced by a high front-to-back antenna ratio, is further reduced by changing the plane of antenna polarization 90 degrees at each terminal and relay point. Basic equipment supplied is commercial RCA CW-20 microwave radio relay.

Civil Defense Doubles Communications Budget

FCDA will spend $6 million on communication equipment and $3 million on noise devices during the 1953 fiscal year. The Federal Civil Defense Administration budget, made up of equal contributions by states and the federal government, represents a complete reversal of the 1952 budget which earmarked $3 million for communications and $6 million for warning devices.

Communications equipment to be purchased includes such items as radio receivers, television receivers, loud-speakers, and portable transmitter-receivers.


EMPLOYMENT-PRODUCTION WORKERS-BY MONTHS
PRODUCTION WORKERS-IN THOUSANDS
ELECTRONICS IN GENERAL
RADIO, TV, PHONO, ETC.
PAYROLLS (EARNINGS AND HOURS) BY MONTHS
WEEKLY HOURS WORKED
WEEKLY EARNINGS-IN DOLLARS
ELECTRONICS IN GENERAL
RADIO, TV, PHONO, ETC.
N D J F M A M J J A S O N D J F M A M
1950
1951
1952
(Source: Bureau of Labor Statistics)

1952 Employment Peak Falls Short

Electronics industry production employment figures level off below predicted high

FALLING SHORT of the expected high, the 1951-1952 electronics production-worker peak reflects material shortages and slow-downs in military spending. Weekly salaries for production workers in radio and electronics continue their steady increase, despite seasonal dip in average number of hours worked. These trends are revealed in the accompanying plot of "Employment and Payrolls" statistics that appear on the "Figures of the Month" page in each issue of ELECTRONICS (p 4).

► **Breakdown**—Figures showing the number of workers engaged in electronics production are obtained from the Bureau of Labor Statistics publication, "Employment and Payrolls". They include personnel involved in such activities as fabricating, processing, inspecting, handling, maintenance and repair of electronic equipment, but exclude those primarily engaged in purchasing, finance, accounting, legal and executive phases of the business.

Earnings and hours statistics are taken from the BLS publication "Hours and Earnings". The salary figures are before deductions and include pay for sick leave, holidays and vacations. Pay for vacations not taken and retroactive pay and bonuses are excluded unless earned and paid regularly each pay period.

Transistors Operate at High Temperatures

SUCCESSFUL operation of junction transistors at temperatures in the neighborhood of 120 degrees Centigrade has been reported by the General Electric Company in Syracuse, N. Y. This is in contrast to previous reports that operation above 75 degrees Centigrade was inherently unstable.

According to John S. Saby of GE, the alloy-diffusion process used in making the junction transistor results in the collector of the transistor having low resistivity. The low resistivity of the collector keeps the current control factor of the transistor constant within a fraction of one percent up to about 120 degrees Centigrade. Formerly, the current control factor would increase above unity with increasing temperature (above 75 degrees Centigrade) and cause instability.

Failure of transistors under high-

(Continued on page 16)

an ounce (and 1/4) → of Protection

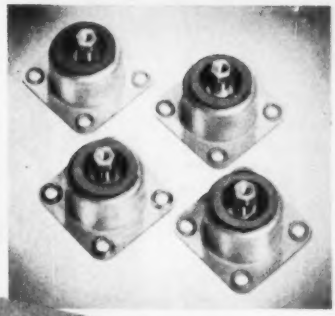
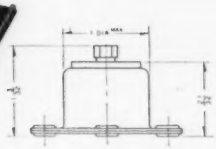


Photo courtesy Vapor Heating Corp.



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6. Four styles — available as unit isolators or assembled with mounting bases built to your needs.

TYPE 6475

TYPE 6695

TYPE 6465

TYPE 6690

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temperature conditions has been a major obstacle. With this problem at least experimentally licked and high-frequency operation possible (ELECTRONICS, Aug. 1952, page 10), the chief obstacle remaining seems to be quantity production.

Tell-Tale Cars Speed Subway Travel

Train equipped with "electronic describer" signals destination before entering station

NEW YORK CITY'S subway system, one of the safest railroads in the world, is ever on the alert to increase safety and speed traffic. Latest device undergoing test will undoubtedly be called AETID by some newsman because it is officially described as "automatic electronic train identification device". Originator of the idea, Cameron A. Reed, Engineer of Line Equipment for the Board of Transportation, is emphatic that he does not consider it a safety device. Other engineers think it does contribute to safety.

► **How It Works**—A coil tuned to some frequency between 50 and 220 kc and requiring no energy sticks out from the first car of a train. Alongside the track is another coil, tuned to the same frequency and connected into a Wheatstone-bridge circuit. As the train passes, the bridge is unbalanced and a relay rings an alarm or lights a lamp. Other coils have no effect.

► **How It is Used**—A train on the Independent line coming into 59th St. station is identified by the towerman from the pattern of colored lights displayed on the front car. He throws switches to send this train onto either the 6th or 8th Ave. tracks. If he makes an error, there is no danger to the passengers but there is considerable inconvenience and the towerman gets the next day off—without pay. The electronic describer will help avoid such infrequent errors.

Boxed Orthicon Is Lightest Camera

Designed for closeups during fight telecasts, this new portable tv camera developed by Robert Sammon of CBS contains only an image orthicon tube and controls. It is connected by cable to sweep and video circuits in a standard studio camera some 15 feet away. Equipped with a bullseye view finder, it weighs 22 pounds

Technical Book Prices Rise

Labor, constituting 80 percent of cost, is chief reason for trend to 2¢-a-page books

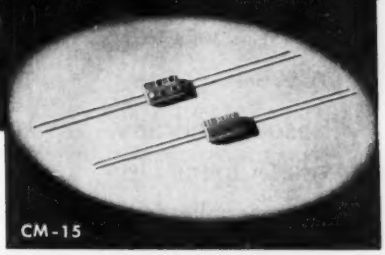
PUBLISHERS of engineering books today have a double worry—about costs and prices of the books they do put out, and about the books they can't afford to publish.

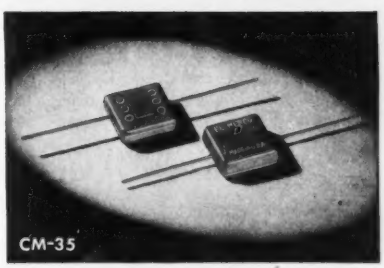
In the early '40's it took only about 5,000 copies to reach a satisfactory profit position (regain production, editorial, promotion and overhead costs) on a new technical book. Today, however, around 8,000 copies must be sold in order to get back the original investment, even with the book priced at the new 2¢-a-page level. This means that many meritorious specialized manuscripts without such high sales prospects will go unpublished, unless some publisher has the nerve to price them at the required break-even figure of 3¢ or even 4¢ a page. Success of such a gamble hinges on willingness of engineers to pay upwards of $10 even for the books they need badly.

► **Cost Breakdown**—The raw materials of books are paper, ink and binding; their cost, added to prorated amortization of plant, equipment, engraving metal and printing metal, amounts to 20 percent of the cost of manufacturing a new scientific book. The balance is labor—for editing, type-setting, making drawings, making engravings, operating the presses, proof-reading, and binding.

The labor portion of this cost has almost doubled in the past ten years, paper has gone up 54 percent, binder's cloth 75 percent, binder's board 58 percent, and even the gold leaf for stamping covers has gone up 56 percent. As a consequence, the book that cost $1 a

(Continued on page 18)





This is why El-Menco Capacitors are designed for the ultimate in reliability and are built with razor-edge accuracy.

Lessons have been learned from surgery . . . today a doctor always allows a large margin of safety in standard operations. For long life and freedom from failure in your electronic applications every El-Menco Silvered-Mica Capacitor is factory-tested at more than **double** its working voltage.

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JOBBERS AND DISTRIBUTORS: For information write to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U. S. and Canada.

WRITE ON YOUR BUSINESS LETTERHEAD FOR CATALOG AND SAMPLES

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MOLDED MICA CAPACITORS **MICA TRIMMER**

Radio and Television Manufacturers, Domestic and Foreign, Communicate Direct With Factory—

THE ELECTRO MOTIVE MFG. CO., INC. **WILLIMANTIC, CONNECTICUT**

copy to produce in 1942 is today costing close to $1.75 a copy.

Author royalties, generally 10 percent of retail selling price, go up whenever a book price is boosted. Promotion, advertising, mailing and other incidental costs likewise go up. Selling prices have not risen at the same rate, because publishers kept hoping that costs would stop rising and because they were afraid of market resistance to higher prices.

Net profit on books has dropped steadily downward in the last four years. Whereas traditionally publishing contracts have been so calculated that overall profit on the average book was divided about equally between author and publisher, today the author is making about twice as much as the publisher. The only shining light in the picture for publishers, albeit very dim, is that federal income taxes go down when income goes down.

Ultrasonic Therapy Market Opens Up

One company already has units in production for treating organic disease

INTEREST in ultrasonic therapy among American medical men has been negligible until recently, although units have been manufactured and used in Europe for ten years.

Experiments of physicians here are now reported to show that ultrasonic energy can be used in alleviating some organic diseases.

Ultrasonic vibrations being applied to the spinal column of a patient

►**How It Works**—One technique is to apply ultrasonic vibrations to the spinal cord of a patient. The human nervous system is said to conduct high-frequency vibrations to other parts of the body and so stimulate hormone production to combat disease. Some danger lies in the fact that too much energy could injure the nervous system.

An ultrasonic therapy unit is being manufactured by the Birtcher Corporation of Los Angeles, California.

Emerson Electric Explains Contract Loss

ALTHOUGH a $105-million Emerson Electric Mfg. Co. contract for the intricate A-2 remote fire control system for B-47 tail armament was cancelled by the Air Force last year (Oct. 26, 1951), the action only recently received widespread newspaper publicity. Stories were considered so misleading by the St. Louis firm that it sent a special letter of explanation to its stockholders:

► **History of Contract**—In January 1945 Emerson Electric started research and development on an advanced type of fire control system comprising over 20,000 parts, to be used in the Boeing six-jet B-47 bomber for controlling the tail-turret guns automatically from an up-forward radar-aiming location. The next six years were a story of one difficulty after another, with the Air Force continuing to pour in money because success always seemed just around the corner. Critical stability problems in a highly advanced system design were the chief trouble.

By January 1951, engineering time was running out and the company was given a "must" schedule of deliveries to meet requirements of the B-47 program. The engineering changes still needed were scheduled to be made as production progressed. Systems already delivered were to be modified at the installation point.

► **Interim System**—The modification program did not work out. On May 7, 1951 production was stopped, and the Air Force ordered Emerson Electric to concentrate on making the system "reliable." Bomber production continued, however, and tail-turret controls were badly needed. In September, the company was requested to provide an interim armament system using certain major components of the original system, with plans for swinging back to the original design as soon as it proved satisfactory.

In October 1951 the Air Materiel Command cancelled the original Emerson A-2 contract; plane manufacturer requirements far exceeded production capacity of Emerson's government-owned armament plant at that time, forcing the decision to use the simpler alternate system.

Engineering work is continuing on the original system, with a recent prototype undergoing extensive tests on a bomber. The basic design is considered fundamentally sound. The troubles encountered with it are considered typical of those encountered when taking the calculated risk of developing extremely complex equipment for military aircraft concurrently with design and production of the aircraft itself.

American Airlines Buys New A-12's for DC-7's

Company reaffirms faith in aviation electronics after mishap with automatic pilot

AVIATION ELECTRONICS took what seemed to be a hard knock last month when American Airlines discontinued use of automatic pilots in certain of their commercial airliners following a malfunction during operation that caused one of these planes to assume an irregular attitude in flight.

That this action was not a

(Continued on page 20)

marion's NEW metertester

MODEL M-2

MEASURES SENSITIVITY AND RESISTANCE

for testing and calibration of D. C. instruments in the laboratory and on production lines

Marion's New Metertester (Model M-2) retains proven Marion features but increases application flexibility. In addition to improved circuitry for sensitivity measurement it also measures internal resistance of sensitive instruments without exceeding full scale rating of the instrument under test.

FEATURES

- Regulated Power Supply
- Stepless Vacuum Tube Voltage Control
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- Marion Ruggedized Null Indicator movement for bridge balance indication
- Decade of .1% accurate Manganin Wire Wound Resistors
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- Complete. No accessories required

SPECIFICATIONS

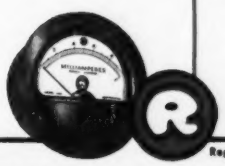
ACCURACY: Overall better than ¼ of 1%
RESISTANCE RANGE: 0-5000 ohms
POWER SOURCE: 115V A C 60 cycles
CASE SIZE: 15½" x 10⅛" x 5⅝"
WEIGHT: 15 lbs.

SENSITIVITY RANGES

0-25UA	0-200UA	0-800UA	0-10 MA
0-50UA	0-400UA	0-1 MA	0-100 Volts
0-100UA	0-500UA	0-5 MA	

The New M-2 Model can also be used for additional purposes, such as a precise source of DC current and voltage and as a precision Wheatstone bridge in the 0-5000 ohm range.

For further information write Marion Electrical Instrument Co., 401 Canal Street, Manchester, N. H., U. S. A.



marion meters

Reg. U.S. Pat. Off.

MANUFACTURERS OF RUGGEDIZED, HERMETICALLY SEALED AND STANDARD PANEL INSTRUMENTS

blanket rejection by that company of all electronic flight equipment was vividly illustrated when American later announced that a complete complement of new automatic control equipment will be installed in its new fleet of Douglas DC-7 Flagships.

▶**Improved Model**—The 25 new ships now on order will be equipped with Sperry autopilots complete with automatic approach couplers and a newly-developed automatic cut-off device to prevent such violent maneuvers as might be caused by autopilot misbehavior.

The new automatic cutoff consists of a pair of accelerometers, one in the nose and one in the tail of each ship. These measure vertical acceleration and are thus able to measure angular acceleration about the pitch axis of the aircraft. Improper relationship between autopilot signals and the airplane's angular motion causes the detectors to signal the human pilot to take over manually.

PERT CLEVELAND LASS gets pointers on an electron microscope at the National Instrument Show where . . . . .

Instrument Makers Stabilize Lines

New offerings scarce, manufacturers exploit last year's strides

COMMERCIAL exploitation of instruments designed within the last two years rather than introduction of brand-new models characterized displays of 198 manufacturers exhibiting at the seventh National Instrument Conference and Exhibit held September 8-12 in Cleveland's public auditorium.

The show belonged predominently to smaller manufacturers, some larger instrument makers having decided that progress in the field warrants exhibition only every other year.

▶**Computers**—Electronically, the most significant development was emergence of the computer from the laboratory into the field of instrumentation. This has been hailed as a long step towards fully-automatic control of industrial operations.

One electronic analog computer on display handles differential equations up to the seventh order and incorporates 12 amplifiers. Another boasts 24 amplifiers and handles twelfth order equations. With an improved cooling system, this machine uses regular-sized tubes.

▶**New Products**—A novel temperature and strain-gage recorder was introduced that permits a-c amplification of low-level d-c voltages. An electronic chopper inverts the signal at a 50 kc rate.

A unique capacitor-follower recorder minimizes indicator loading. A vane, acting as one plate of a variable capacitor, is mounted on the indicating galvanometer pointer. The other plate is mechanically coupled to a servo motor controlled by an electronic capacitance relay. The servo drives the recording pen.

Other instruments included a surface-roughness gage operating on the principle of a phonograph pick-up and a viscosity meter deriving its information from the damping rate of an ultrasonic pulse.

Industrial control devices were largely of the temperature, pressure, rate-of-flow and liquid level regulating type applicable mainly in chemical plants and other process industries. Midget electronic components for process control have recently met with wide acceptance by larger chemical and petroleum manufacturers.

The navy exhibited a halogen-filled Geiger-Mueller tube using no critical materials and a vector airborne magnetometer using three saturable inductors as sensing elements.

▶**Foreign Competition**—Rumblings that may portend the return of Western Europe's master instrument makers to the American market were heard at the show. One Dutch firm and three Swiss concerns displayed their wares and an American manufacturer exhibited a line of Danish instruments.

Further evidence of increased productivity in Europe was found in announcement of the first International Instrument Congress and Exposition, scheduled for Philadel-

(Continued on page 22)

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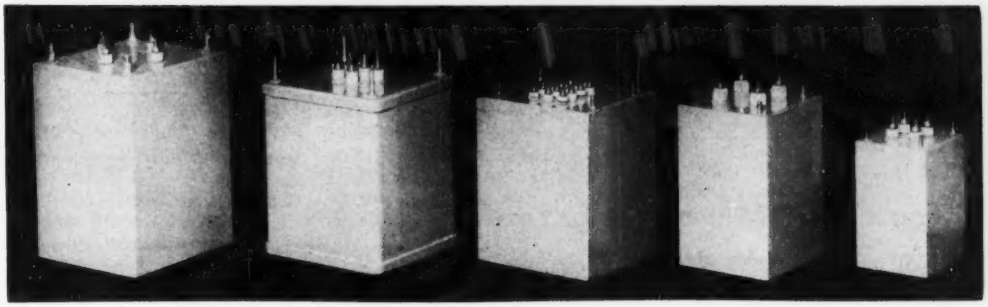

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The solution of these problems requires elaborate test equipment and a different design and manufacturing technique. Our laboratory equipment permits the measurement of phase angles as small as .02 milliradians and minimum ratio errors of .01%. Our manufacturing equipment enables us to produce ANY type of transformer, and our raw material inventory includes all core alloys in all common sizes, in addition to toroidal cores.

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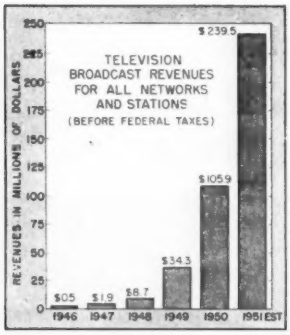
STATIC ELECTROMAGNETIC DEVICES

phia's museum and convention hall, September 13-25, 1954. The next national instrument show will be held in Chicago, Sept. 21-25, 1953.



TV Income Topped $239 Million

TELEVISION network and independent station revenues (time, talent and program sales) for 1951 totalled $239.5 million, more than twice the 1950 figure.

Networks, including owned and operated stations, grossed $132.2 million, with expenses of $119.8. (For the first time, the networks received more from tv than from a-m with its $100.4 million gross and $90 million expenses.) Income from combined a-m and tv networks came to $22.8 million, more than double the 1950 income of $8.7.

Ninety-three independent tv stations reported totals of $107.3 million compared with 1950's $50.4. With station expenses increasing at a slower rate, the 1951 station income was $31.2 million as compared with $0.8 million in 1950.

►**Individual Income**—Of the 106 stations reporting preliminary figures to the FCC, 93 showed a profit in 1951. Median income was $350,000 as compared with a median for 53 stations in 1950 of $129,000.

Seven of the 13 losing tv stations reported losses of $200,000 or less, while two reported losses in excess of $800,000. Eight of the thirteen losing tv stations were located in the two seven-station markets—New York and Los Angeles.

TV Component Delivery Near Normal

Receiver manufacturers report delivery time at 4 to 6 weeks for most parts

TELEVISION RECEIVER manufacturers are reasonably happy about the component supply. Deliveries of most parts are only 2 to 3 weeks behind normal and are being made in quantities ordered, a survey of leading set producers reveals.

A few set makers are feeling a pinch in the supply of 21-inch picture tubes which now are used in the lion's share of tv set production, but they expect the shortage to be quickly overcome. One manufacturer notes that electrolytic capacitors are taking as long as 8 weeks to deliver and another reports a 16-week lag in chassis delivery.

►**Early Pickup**—The earlier-than-usual upswing in tv sales this year caught some component manufacturers with their inventories down. The rise came in July, about a month and a half ahead of the usual time.

Set producers see three main reasons for the early tv sales increase. The defreeze started the ball rolling; early opening of the Denver market helped bring inventories down to the present level of about 240,000 sets. Then the political convention telecasts promoted sales for all tv manufacturers during the traditional summer slump.

The fact that the majority of leading set producers brought out new lines ahead of time to tie in with the political convention promotions also contributed heavily to the tv sales upswing. In July, tv production was 34 percent higher than it was for the same month in 1951. During August, each weeks production topped the preceding week by a good margin.

►**Outlook**—Some component manufacturers do not share the present optimistic attitude of tv set manufacturers concerning the supply situation. Selenium rectifier manufacturers, for example, recently advised NPA that fewer of their products may be available for tv sets in 1953 because of military requirements. Loudspeaker manufacturers also expect shortages in production because of lack of steel. They predict that set manufacturers may feel the pinch in the next few months.

Russian Periodicals Available in U.S.

Some technical information on radio and electronics flows freely from east to west

RUSSIAN equivalents to ELECTRONICS and other western technical journals are available in this country in certain libraries. Through these publications, with a little effort in translating, the western engineer can keep fairly well abreast of advances made by his eastern counterpart.

For example, an article in one Russian magazine describes a new ultrasonic microscope with complete details of theory, construction and operation. Another describes Russian progress in transistors and presents experimental results obtained by subjecting various semiconductor materials to a wide variety of operating conditions. The article credits O. V. Losev with having developed a semiconductor device capable of producing oscillations in the early 1920's.

Much information is dispersed in report form. One such report tells of successful use of ultrasonic energy in processing steel. Others describe progress at virtually all levels from pure theoretical dissertations to experiments and projects for hobbyists.

►**Sources**—According to Gilbert B. Devey, whose search of the Library of Congress Slavic Room and the MIT Science Library inspired this article, Russian technical language is relatively easy to

(Continued on page 24)

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Contains only virgin tin and lead. Tin — 99.35% pure. Lead — 99.97% pure.
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read by the "hunt and peck" method, with a Russian-English dictionary.

Lists of Russian publications are available as follows: "Serial Publications of the Soviet Union", published by the Library of Congress, Washington 25, D. C., "Guides to Russian Scientific Periodical Literature", Brookhaven National Laboratory, Upton, New York (Available through Office of Technical Services, Department of Commerce, Washington 25, D. C.) "Monthly List of Russian Accessions", Library of Congress, Washington 25, D. C.

Automatic ILS System Released

Lear F-5 demonstrates ability to guide planes smoothly to point of touch-down

BY ADDING 79 pounds and $13,750 worth of electronic components, commercial aircraft can now be flown to within five feet of an ILS-equipped runway with only air-speed control by the pilot. This advance in flying was demonstrated to ELECTRONICS by inventor-engineer Bill Lear in New York on June 12 as his company made the hitherto military F-5 autopilot available for civilian use.

The 27-tube (all 12AY7's) autopilot has many features that make it unique. Most noticeable of these is the smooth control afforded by circuits that average error signals and thus avoid violent maneuvers due to momentary signal discontinuities. In fact, if the plane is on the glide slope for one minute or more, it will continue steadily toward the point of touch-down even if the ILS transmitter fails.

Military airplanes of the F86D, F89 and F84G types already incorporate the F-5. This same 8 x 10 x 13-inch package can be used to fly automatically any plane from a B36 intercontinental bomber to a single-engine lightplane such as the Beechcraft Bonanza.

Printed Circuits Cut Home Radio Costs

PRODUCTION of home radios with printed circuits, and using dip soldering, will begin in mid-October at Hallicrafters. Using a recently-developed "power print" process, in which unwanted copper is photographically etched away from a plastic base, over 100 hand operations will be eliminated, according to Bill Halligan, president of the company.

In rough figures, a particular radio that now requires 100 girls to produce 1,000 sets a day will in the future require 20 girls, because the new technique permits use of single-dip soldering. Eventually, the process may reduce the cost of tv and radio sets by as much as 25 percent.

Sightless TV Keeps Up With the Joneses

Sound-channel receiver provides all vhf bands and f-m broadcasting

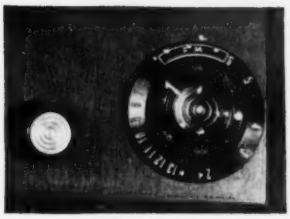
KEEPING up with the Joneses is as important to sightless persons as to the rest of us, and sometimes more so.

Just as children of a televisionless family feel socially outcast, so blind children and adults both feel left out of the main stream of life when they lack knowledge of tv personalities. Workers with the blind say this frame of mind tends to make the sightless person withdraw further from contact with the world.

To supply this lack, Herbert Abrams, president of Pyramid Television Service Co., New York City, put together a simple table radio receiver that tunes in the sound on tv channels 2 through 13 and all f-m channels.

A standard tuning unit is modified so that a detent device emits clicks as the dial is moved from one tv channel to the next.

Engraved numbers also serve to identify channels through the sense of touch. Across the f-m band, where the clicks are missing, raised dots on both the outer dial and the inner vernier show a pattern that can be interpreted by fingertips as broadcast channels. The only other knob operates a combination volume control and on-off switch.



Screenless tv controls in one corner of front panel include on-off volume control (left) and tuning dial (right). As each channel is tuned in, the dial clicks. Raised dots over the f-m range where there are no clicks give Braille-like channel identification

► **Soon Available**—Although the set is expected to sell for $50 to $65, it is simpler, less bulky and more easily moved about than even the smallest, most inexpensive television receiver. Its simplicity is expected to result in lower maintenance costs and greater reliability.

The New York Guild for the Jewish Blind, a nonsectarian agency for the blind and visually handicapped, will distribute the screenless tv set as soon as demand has been established and a manufacturing program is set up.

Radar Heads U.S. List Of Electronics Orders

REPORTS from RTMA members show $538,794,477 in electronics orders from the U. S. Government in the first six months of the current year.

Radar heads the list at $263,-131,886. Communications equipment ran second at $160,-693,327 and radio navigation aids accounted for $45,423,158. Sonar orders amounted to $10,783,-

(Continued on page 26)

testing samples available on request.

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Our complete facilities for volume production help to cut your costs, for Clevelite is unparalleled in its price class.

Our engineers will be glad to work with you to develop your special needs.

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479, laboratory and test equipment $13,459,401, and miscellaneous, $45,296,101.

Billings to the government by RTMA members for the same period jumped from $76 million in 1951 to $243 million this year.

Experimental UHF TV Goes Commercial

RCA'S PIONEER experimental uhf tv transmitter at Bridgeport, Connecticut may soon become the pioneer commercial uhf tv station in the country.

Operating experimentally since 1949, it was recently sold to Empire Coil for use in Portland, Oregon.

The equipment is being modified to operate on the Portland channel and should be in service by Thanksgiving, possibly by election day.

►**20 Left**—Shift of KC2XAK to commercial service brings the number of experimental tv stations in the U. S. down to 20. Following is the current list of experimental stations now in operation or with CP grants.

Stations

Call Letters and Licensee	*Frequency in mc*	*Power a—aural v—visual*
KG2XAZ—Assoc. Broadcasters, main transmitter, Bethlehem, Pa.	511–519	5 kw 500 w v 250 w a
booster, Easton, Pa.		50 w v 25 w a
KQ2XBB—Radio Electronic TV School, Detroit, Mich.	500–520	400 w v 50 w a
KE2XIA—CBS, New York, N. Y.	470–476	1 kw v 1 kw a
KQ2XBH—Crosley Broadcasting Corp., Cincinnati, O.	529–535	100 w v 50 w a
KE2XDN—DuMont Labs, New York, N. Y.	600–620	1 kw v 1 kw a
KE2XDR—DuMont Labs, New York, N. Y.		1 kw v 1 kw a
	700–720	5 kw v
KE2XHZ—Federal Tel. Labs, Nutley, N. J.	ch 2–13 (incl)	5.5 kw v 3 kw a
KE2XHX—General Electric Co., Syracuse, N. Y.	ch 2–13 and 480–890	50 kw v 25 kw a
KA2XBD—Kansas State, Manhattan, Kan. (L)		400 w v 200 w a
KM2XBB—Paramount TV, Los Angeles, Calif.		100 w v 50 w a
KM2XCW—Television Calif., San Francisco, Calif.	580–630	1 kw v
KG2XCV—Philco, Phila., Pa.	6,875–6,900	0.1 w v
KM2XAD—Pacific Video Pioneers, Mt. Wilson, Calif.	520–540 780–800	200 w v 100 w a
KS2XBR—Zenith, Chicago, Ill.	512–528	1 kw v 1 kw a
KS2XBS—Zenith, Chicago, Ill.	ch 2	1 kw v 500 w a
KG2XDI—Conestoga TV Lancaster, Pa.	590–610	5 kw v 2.5 kw a
KG2XDU-Sylvania, Emporium, Pa.	509–529	300 w v 100 w a
KG2XEL—Sylvania, Emporium Pa.	878–884	30 w v 10 w a
KG2XEJ—Sylvania, Emporium, Pa.	1,990–2,008	0.2 w v
KG2XEV—Sylvania, Emporium, Pa.	2,042–2,059	0.2 w v

MEETINGS

OCT. 1-3: Canadian Electrical Manufacturers Association, General Brock Hotel, Niagara Falls, Ont.
OCT. 3-4: American Society for Quality Control, Sheraton Hotel, Worcester, Mass.
OCT. 6-8: NAED, Fall Meeting of the Pacific Zone, Hotel del Coronado, Coronado, Calif.
OCT. 13-17: AIEE Fall General Meeting, New Orleans, La.
OCT. 20-22: Radio Fall Meeting, RTMA Engineering Department, Hotel Syracuse, Syracuse, N. Y.
OCT. 20-24: National Metals Show, Philadelphia Auditorium, Philadelphia, Pa.
OCT. 21-23: Twenty Ninth Annual Session, Communications Section, Association of American Railroads, Edgewater Gulf Hotel, Edgewater Park, Miss.
OCT. 26-29: NAED, Meeting of Board of Governors, Grove Park Inn, Asheville, N. C.
OCT. 28-30: AIEE Middle Eastern District Meeting, Commodore Perry Hotel, Toledo, Ohio.
OCT. 29-NOV. 1: Audio Fair, Hotel New Yorker, New York, N. Y.
NOV. 5-7: Sixteenth Annual Time and Motion Study and Management Clinic, Sheraton Hotel, Chicago, Ill.
NOV. 7: IRE Microwave Professional Group, Symposium On Microwave Circuits, Western Union Telegraph Co. Auditorium, New York, N. Y.
NOV. 10-13: NEMA, Haddon Hall, Atlantic City, N. J.
NOV. 10-30: International Radio and Electronics Exhibition, Bombay, India.
NOV. 17-18: AIEE, Technical Conference on Recording and Controlling Instruments, Benjamin Franklin Hotel, Philadelphia, Pa.
NOV. 19: American Standards Association, 34th Annual Meeting, Waldorf Astoria, N. Y.
NOV. 21-22: Fourth Annual IRE Regional Papers Technical Conference, President Hotel, Kansas City, Mo.
DEC. 10-12: IRE-AIEE Computer Conference, Park Sheraton Hotel, New York, N. Y.
JAN. 14-16, 1953: Joint AIEE-IRE Conference on High Frequency Measurement, Washington, D. C.
FEB. 4-6: Western Computer Conference, Hotel Statler, Los Angeles, Calif.
FEB. 5-7: IRE Southwestern Conference and Electronics Show, Plaza Hotel, San Antonio, Texas.
MARCH 9-12: NEMA, Edgewater Beach Hotel, Chicago, Ill.
MARCH 23-26: IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.
MAY 11-13: National Conference on Airborne Electronics, Dayton, Ohio.
MAY 24-28: NAED, 45th Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

Business Briefs

►**Magnetic Recorder** plugged into toll telephone lines to announce delays when circuits are busy is expected to release operators for active duty during rush times, like Christmas.

►**Pinholes** in telephone cables formerly detected by leaking gas and application of soap that blew bubbles will be pinpointed in future by an electronic sniffer. The GE device (ELECTRONICS, p 100 Mar. 48) pulled along a cable filled with Freon 12 ($CC1_2F_2$); rings a bell at the leak.

►**Telecommunications** Planning Committee appointed by Haraden Pratt, advisor to the President, includes representatives of Office of Transportation and Communications Policy (State Department); Communications-Electronic Director of the Joint Chiefs of Staff (Department of Defense); Administrator of the Civil Aeronautics Administration (Department of Commerce), Federal Communications Commission and Central Intelligence Agency. New committee will plan and advise, not operate or procure.

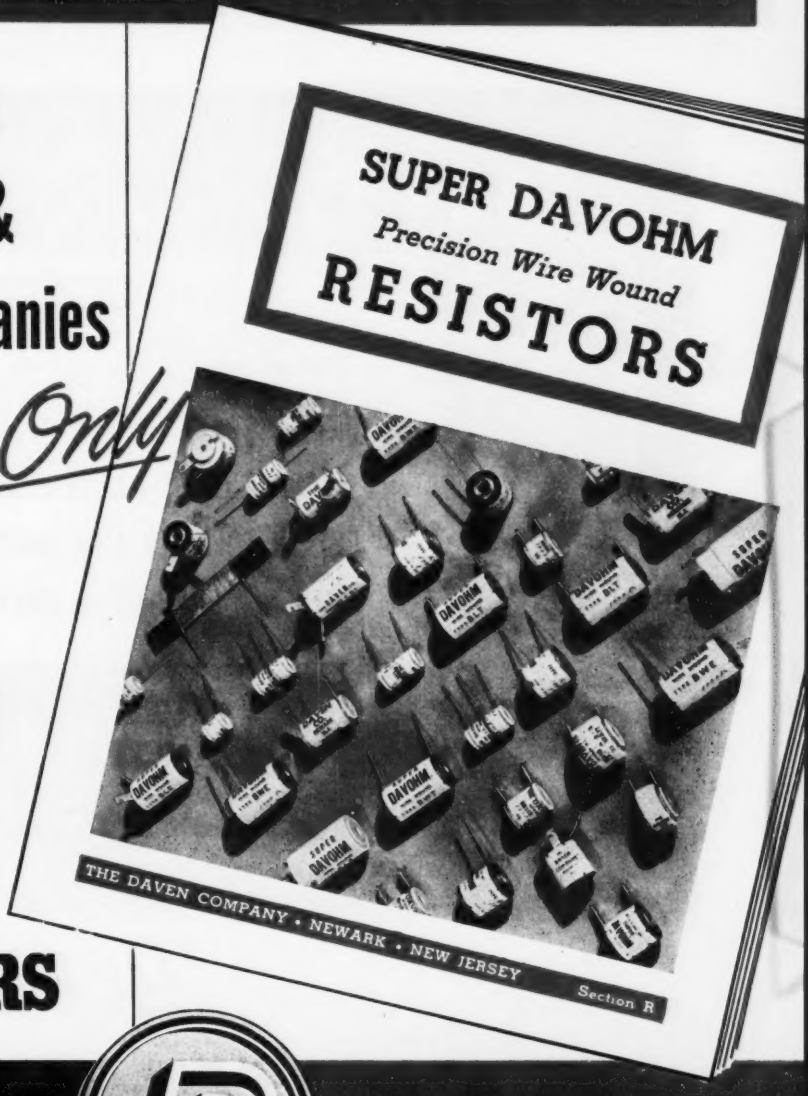
►**Reduction** in sales taxes on wireless sets and tubes has been ordered by the Australian government to help the electronics industry. On an average wireless set, drop will amount to an estimated $15.

►**Popocatepetl**, the 17-thousand foot volcano in Mexico, is the site on which a tv signal repeater station may be constructed to send Mexico City tv signals to the Gulf seacoast city of Vera Cruz.

READ THIS!

To Find Out Why More & More Companies *Specify Only*

SUPER DAVOHM
Precision
Wire Wound
RESISTORS

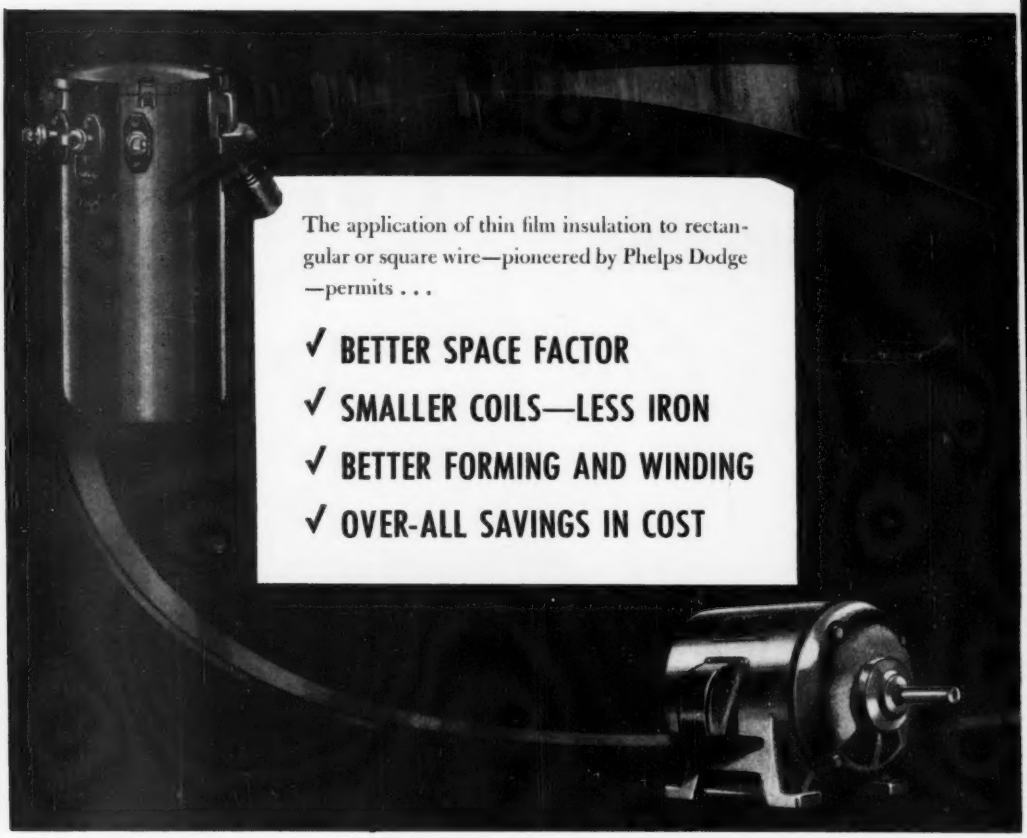


It's FREE
Write for
Bulletin R Now!

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

Phelps Dodge Rectangular

SAVE SPACE—IMPROVE



The application of thin film insulation to rectangular or square wire—pioneered by Phelps Dodge —permits . . .

- ✓ BETTER SPACE FACTOR
- ✓ SMALLER COILS—LESS IRON
- ✓ BETTER FORMING AND WINDING
- ✓ OVER-ALL SAVINGS IN COST

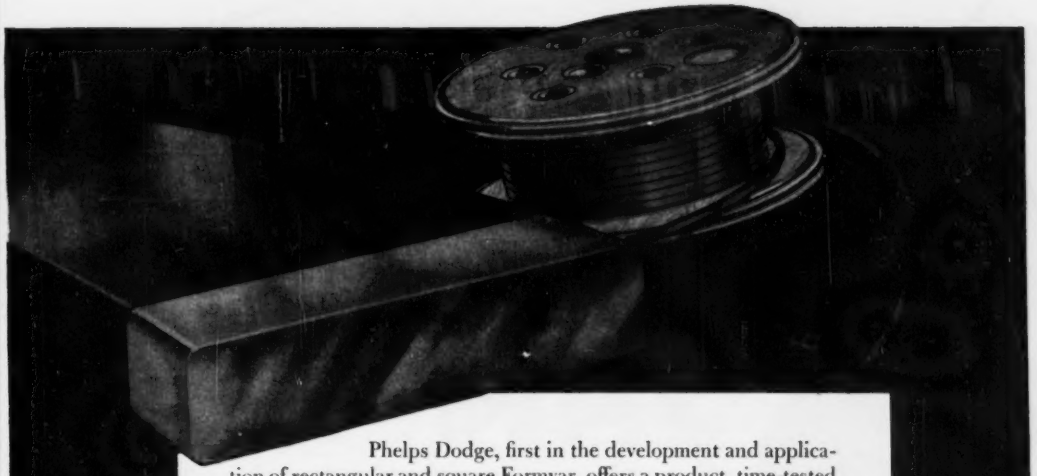
"It takes the best

PHELPS DODGE COPPER PRODUCTS

CORPORATION

or Square Formvar Helps You

DESIGN AND EFFICIENCY



Phelps Dodge, first in the development and application of rectangular and square Formvar, offers a product, time-tested for applications where space is at a premium and where the outstanding abrasion, chemical and forming properties of this *thin film* magnet wire can be utilized. When used under fabric (glass and cotton), it improves dielectric and moisture resistance, and makes possible over-all savings in the insulation system. Available in volume over a complete range of sizes.

Any time magnet wire is your problem, Phelps Dodge has the quickest, easiest answer!

to make the best!"

INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

STACKPOLE
Fixed Composition
Resistors
in accordance with
JAN-R-11
specifications
Electronic Components Division
STACKPOLE CARBON COMPANY, St. Marys, Pa.
RC41
RC42
RC30
RC31
RC10
RC20
RC21
A DEPENDABLE SOURCE OF RESISTOR SUPPLY for over 20 YEARS

The Reader AUDITED PAID CIRCULATION ABC *His Mark*

THE ABC SYMBOL which is printed at the head of this page is, in a very real sense, *your* brand on this magazine. Those letters stand for Audit Bureau of Circulations. The symbol indicates that the magazine is a member and supporter of that Bureau.

To the advertiser who contemplates using the magazine as an advertising medium, this symbol has a well-recognized significance. It tells him that the circulation records and practices of the magazine are wide open to the auditors of the Bureau, who check the publisher's claims and make public the precise terms and conditions under which subscriptions are obtained. And it assures him that the magazine stays in business by virtue of a demonstrated demand from its readers as shown by their paid subscriptions or newsstand purchases.

BUT HERE we are concerned only with the significance of ABC to you as a reader. For when the advertisers, the advertising agencies, and the publishers founded the Bureau nearly forty years ago to help establish honest circulation figures, they unwittingly set up a cooperative institution that has become a major safeguard for the interests of the reading public.

That is because membership in ABC constitutes one of the strongest guarantees that any publication can offer of its primary devotion to the interests of its readers. And by making that guarantee possible, ABC becomes a major safeguard of the freedom of the press, an objective of exceptional importance in these days when the public is flooded with propaganda from so many sources.

THE SUREST MEANS by which to preserve a free press is to keep it directly answerable to the reading public it would serve. It follows, then, that the survival of a truly free press must depend on its acceptance by that public; and that means in turn that the people must have in their hands some adequate means for holding the publishers responsible to them.

No one has yet devised any means to that end more simple, more direct or more practical than the paid subscription or newsstand purchase price. The right to purchase or refrain from purchasing a publication gives to the readers and to no one else the power to pass judgment on whether that publication should continue to serve the reading public.

TO SUPERVISE this vital process, to check and certify the integrity of the publication's circulation methods and claims, requires a strict and continuing audit of each publication's success in meeting this test of its public acceptance. To that essential function the ABC has contributed mightily by the conscientious performance of its mission. And that is why we are able to have a press supported, for the most part, by advertising revenues, but not controlled as to its circulation or content by any influence other than its readers.

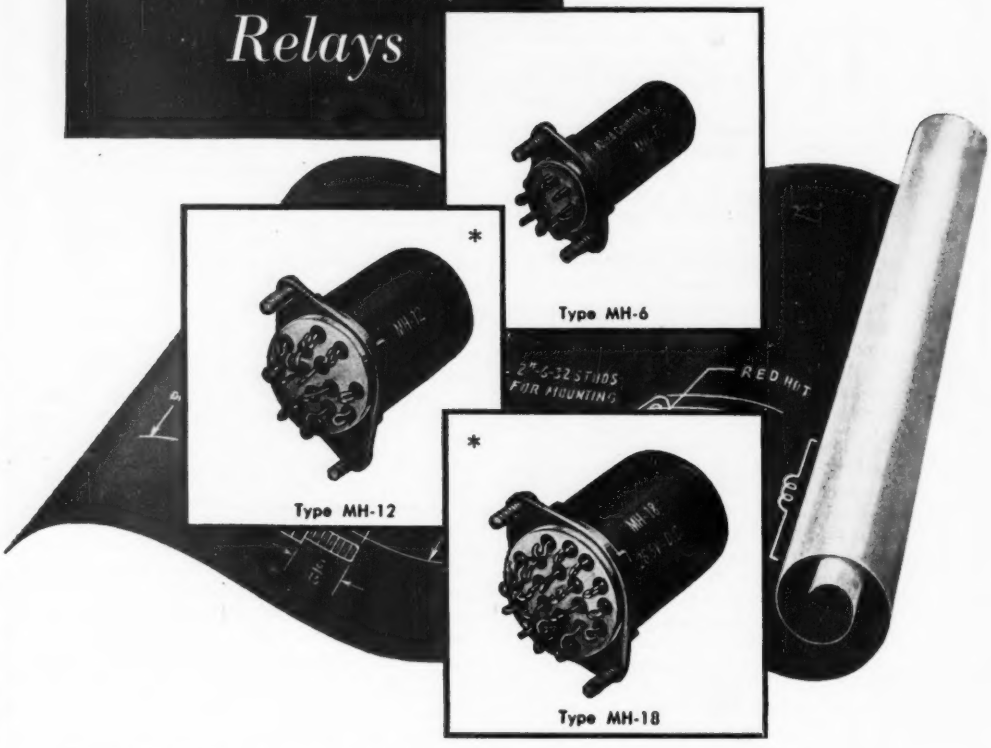
When an advertiser consults the ABC statement of a publication to ascertain the amount, the quality and the trend of its circulation, he does so in the legitimate pursuit of his own interest. But at the same time, inevitably, he is helping the ABC to keep the press responsible and responsive to the reading public. For, in effect, he is asking the publication to demonstrate through its circulation figures that it owes its standing to a voluntary demand by its readers.

SO THE Audit Bureau of Circulations, by auditing and certifying paid circulations, has come to perform a vital service to the readers of this magazine and of every other member publication. And in performing that service, it helps to maintain in our country a press that is answerable to the reading public and to it alone. So long as the practices and principles for which ABC stands continue to prevail in American publishing, we shall find in it a sure support for a truly free press, responsible only to the public it serves.

McGraw-Hill Publishing Company

ALLIED'S NEW 50 G *Sub-Miniature Relays*

* Approved by U.S.A.F. Spec. MIL-R-5757A

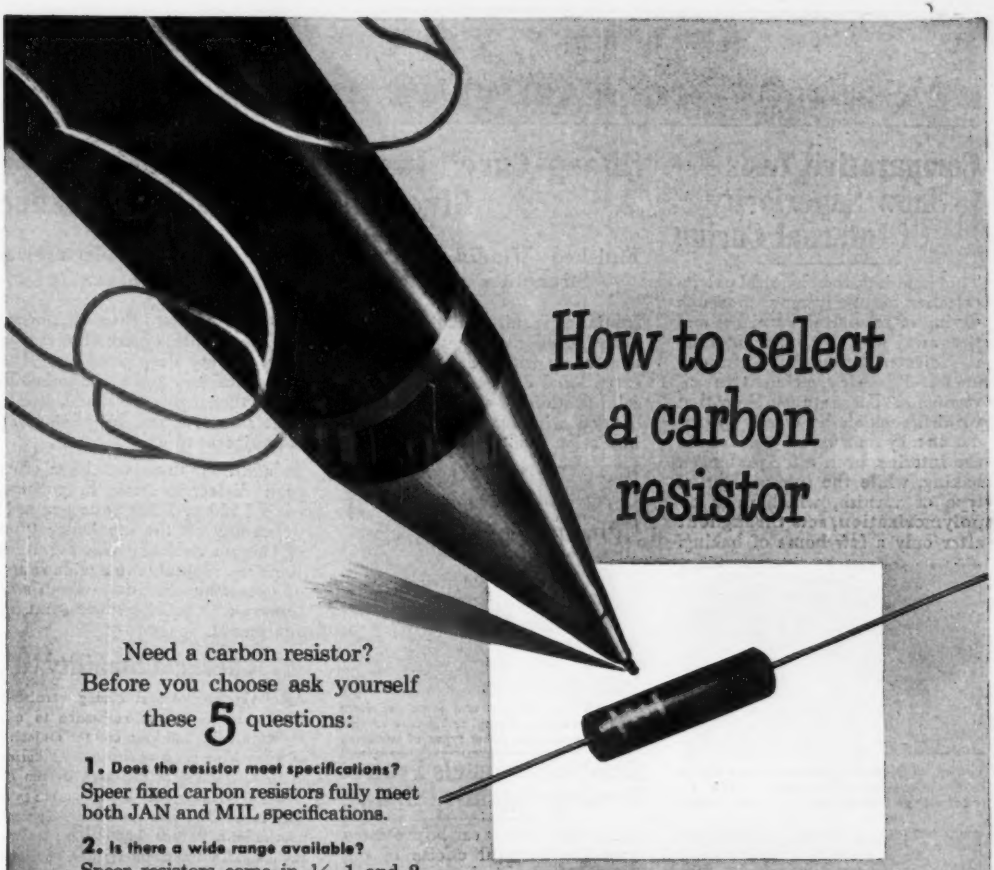


Developed specifically to meet the rigid requirements of U.S.A.F. Spec. MIL-R-5757A, the new Allied line of sub-miniature double throw relays includes the MH-18 (6-Pole), the MH-12 (4-pole), and MH-6 (2-pole). • Contacts are rated at 2 amps resistive or 1 amp inductive at 28 volts D.C. • The high performance of these relays has been achieved in an extremely compact, unitized construction and parallels the most recent advances in airborne equipment design.

For detailed specifications and drawings of these new relays, write for Bulletin 1002

ALLIED CONTROL COMPANY, INC. 2 EAST END AVE., NEW YORK 21, N. Y.

AL 149



How to select a carbon resistor

Need a carbon resistor?
Before you choose ask yourself
these **5** questions:

1. Does the resistor meet specifications?
Speer fixed carbon resistors fully meet both JAN and MIL specifications.

2. Is there a wide range available?
Speer resistors come in ½, 1 and 2 watts in all standard values up to 20 megohms.

3. What is the ambient temperature?
Speer resistors operate up to 40° C ambient.

4. Is the resistor well made?
Speer resistors are carefully controlled at each manufacturing step. They have a carbon core sealed with an outer cover of phenolic resin to give maximum protection.

5. Is the resistor thoroughly tested?
All orders of Speer resistors are given numerous tests for resistance rating, and are backed by an accelerated ten day test for humidity.

Write today for information on specifications.

SPEER RESISTOR

SPEER *Resistor Corp.*

St. Marys, Pennsylvania
A Subsidiary of Speer Carbon Co.
Other subsidiaries: Jeffers Electronics, Inc.
International Graphite & Electrode Corp.

Other Speer Products for the Electronics Industry
anodes · contacts · molded notched* coil forms
iron cores · discs · brushes · battery carbon
graphite plates and rods
also
R. F. Coils · ceramic capacitors · capristors · high voltage condensers · disc capacitors · chokes
made by
Jeffers Electronics, Inc.
*Patented

IRVINGTON INSULATING VARNISH DIGEST

Comparative Tests Show Superiority Of Internal Curing

That heat-induced chemical polymerization results in more thorough drying of insulating varnishes and does away with soft, tacky interiors is indicated by studies performed on test lids with various types of varnishes. These studies show that varnishes which dry chiefly by oxidation may remain soft and tacky in the interior, even after prolonged baking, while the internal curing type of varnish, which dries by polymerization, sets throughout after only a few hours of baking.

Varnish on this test lid—one of a type drying by oxidation—baked two weeks at 220° F., remained soft and tacky in the interior

Internal curing varnish on this test lid set completely after only 8 hours baking at 212° F.

Air Drying Varnishes Have Many Applications

Air drying varnishes produced by Irvington Varnish & Insulator Company find wide use both as a final coat on windings already impregnated with other types of Irvington varnish and as a means of protecting other types of electrical apparatus and improving appearance.

These varnishes are also used as coatings on switch boxes, battery trays, conduit boxes, signal boxes and metallic surfaces in general. Varnishes are supplied in both black and clear types. A list of the major types is available on request.

"Deep-Cure" Insulating Varnishes Give Outstanding Performance

Finished Windings Combine High Dielectric, Mechanical Strength with Exceptional Resistance to Chemicals

Insulating varnishes that cure throughout by heat-induced chemical polymerization offer unusual service advantages, because this method of curing does away with wet, sticky interiors even in very deep windings. The exceptional degree of penetration of these varnishes and their complete solidification on curing combine to assure a thoroughly insulated, firmly bonded winding. These features prevent shorts caused by chafing of insulation resulting from the movement of adjacent turns.

Thorough impregnation and complete curing result from use of internal curing type varnish on these and many other types of windings

In addition, these varnishes offer high dielectric strength, ranging from 1,700 to 2,200 volts per mil, depending on the particular type of varnish used. Specific formulations are adaptable to a wide range of operating conditions, from stationary coils to high-speed rotating equipment.

Finishing Enamels Protect Windings Against Oil, Dust

Insulated windings can be protected from the harmful effects of oil, moisture, chemicals, water and grease by means of a quick-drying coat of a finishing enamel. Formulated specifically for use as a finishing coat, Irvington Enamels are easily applied by brush and dry rapidly to a tough adherent film. Two major types are: No. 32 red, designed to give the fastest drying time consistent with good protection under most service conditions; and No. 30 red, for especially severe service conditions..

Easy to brush on, Irvington Red Enamels protect windings from corrosive action and also improve dielectric properties

Chemical Stability

All Irvington internal curing varnishes have good-to-excellent resistance to oil, moisture, acids and heat, and the majority of them have good resistance to alkalies as well. Because of this high degree of chemical stability, they are adaptable to a wide range of service conditions. Typical applications include high-voltage coils; radio and TV transformers; low, medium and high speed armatures; field coils; oil-cooled transformers; relay coils.

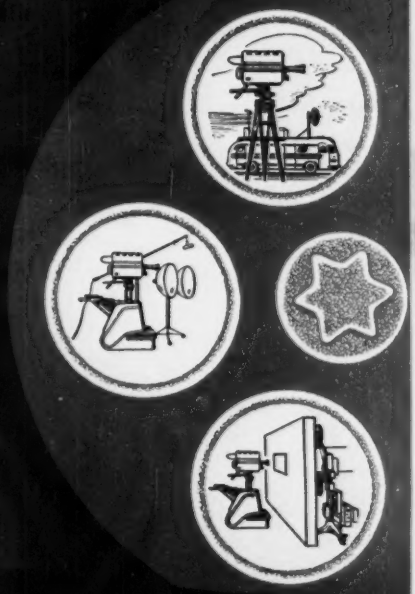
Production Procedures

These varnishes are adaptable to a wide variety of application processes. The vacuum and pressure method is commonly used to assure the fullest degree of impregnation of deep windings. The varnishes may also be successfully applied by dipping. Brush application is used between layers as coils are being wound. All of these varnishes are adaptable to a variety of baking schedules. Their internal curing properties permit application of multiple coatings with only short, partial curing bakes between coats.

Internal curing varnishes are available in both black and clear types, and in formulations that provide either considerable flexibility or high rigidity in the finished windings. In addition, Irvington's Research Department is prepared to assist varnish users in evaluating the properties of varnishes for specific requirements of service performance, methods of application and baking schedules.

[For further information, write the Sales Manager, Varnish Div., Irvington Varnish & Insulator Co., 11 Argyle Terrace, Irvington, N. J.]

triple duty



write for your copy today . . .

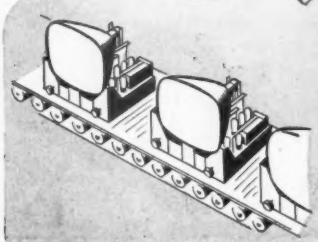
DU MONT

Dept.-EC

However you compute

IRC BT RESISTORS ARE FIRST

By whatever factor you consider most important, IRC filament type BT resistors lead the industry. The next time you specify insulated composition resistors remember—it pays to do business with the leader. Most people do.



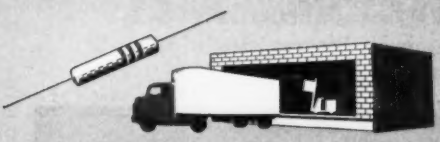
IF QUANTITY PRODUCTION INDICATES LEADERSHIP— ***remember*** more IRC BT resistors are used in radio and TV sets than any other brand. During the last five years IRC supplied 40% of the resistors used in radio and TV set production.

IF QUALITY STANDARDS DENOTE LEADERSHIP— ***remember*** IRC Advanced Type BT resistors meet and beat rigid JAN-R-11 specifications. Nearly all producers of government equipment have tested and approved IRC's advanced BT resistor.

leadership

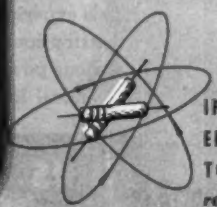
IF GLOBAL ACCEPTANCE REFLECTS LEADERSHIP—

remember **IRC filament type BT resistors are favored in every major market of the world. Licensee plants in Canada, England, Denmark, Belgium, Italy and Australia produce IRC BT's for international electronics.**



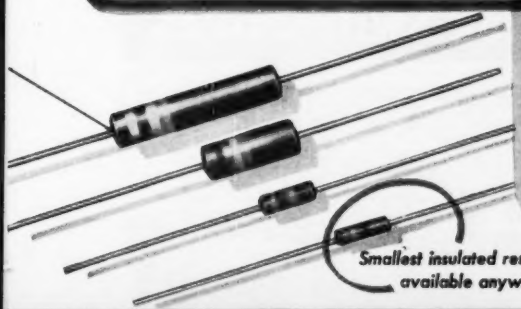
IF DEPENDABLE DELIVERY REPRESENTS LEADERSHIP—

remember **IRC's long record of strike-free labor relations protects your assembly lines. Dependable delivery of Advanced Type BT resistors is further assured by IRC's financial ability to maintain large stocks of wanted ranges and to draw from foreign licensees when demand warrants it.**



IF RESEARCH AND ENGINEERING TESTIFY TO LEADERSHIP—

remember **IRC BT resistors are produced by the largest resistor manufacturer in the world. The finest accumulation of resistance know-how has been pooled in the perfection of these filament type resistors.**



Smallest insulated resistor available anywhere

This coupon brings you full data on IRC BT Resistors

IRC

Wherever the Circuit Says —WW—

INTERNATIONAL RESISTANCE COMPANY

Philadelphia 8, Pennsylvania

INTERNATIONAL RESISTANCE COMPANY
403 N. Broad Street, Philadelphia 8, Pa.

Please send me full data on IRC Advanced Type BT Resistors:—

☐ Also name and address of nearest IRC Distributor who can furnish speedy delivery of BT resistors in small quantities.

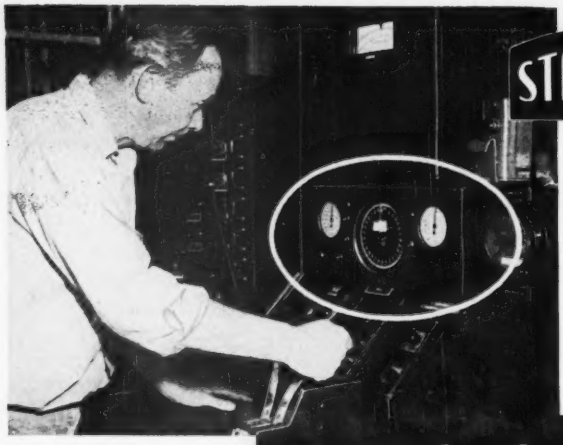
NAME_____

TITLE _____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____



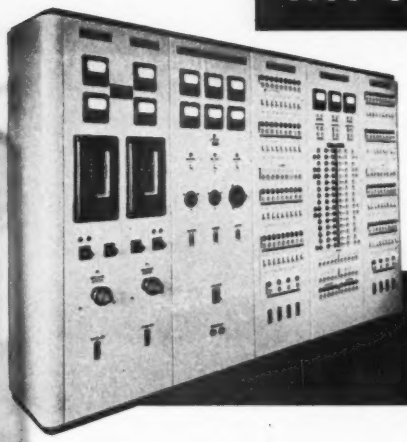
STANDARD

SINCE 1884

WRIGHT AERONAUTICAL DIVISION
CURTISS-WRIGHT CORPORATION

This photograph, taken in one of the experimental cells of the Wright Aeronautical plant at Woodridge, N. J., shows a STANDARD Chronotachometer installed in their test panel.

Not Only Chronotachometers . . .



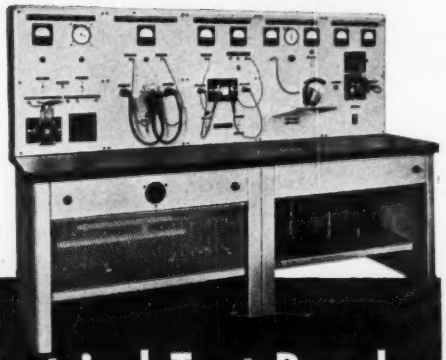
WILSON DAM (T. V. A.)

This experimental control and distribution switchboard handles various power supplies for their Chemical Laboratory Building.

plus "flexlab" Control and Distribution Switchboards

WESTINGHOUSE ELECTRIC COMPANY

This specially designed unit is for the control and test of aircraft timers, series relays, contactors, servo motors, and booster coils. It is typical of the wide range of custom-built equipment by STANDARD.



. . . but all kinds of Custom-built Electrical Test Panels

THE STANDARD ELECTRIC TIME COMPANY

97 LOGAN STREET · SPRINGFIELD 2, MASSACHUSETTS

Now for ultra-high TV ... 200 KW E.R.P. from G.E.'s new 15-KW KLYSTRON!

Highest-power u-h-f transmitting tube!

Linear in operation up to 12 kw sync output! This is ample power to assure superior transmission at 200 kw signal strength, figuring a 20-to-1 antenna increase.

High tube gain! As little as 60 w will drive the G-E klystron at 12 kw output! You save . . . when designing and building your transmitter . . . the tubes and circuitry for one, two, or more intermediate stages needed to drive conventional power tubes.

Built-in r-f—integral with the klystron. You eliminate r-f problems from your transmitter circuit.

Will outlast other power tubes! The bombarded-type cathode of heavy pure tantalum (1) withstands metal loss during operation, (2) eliminates stripping and "poisoning". The heater of pure tungsten operates at relatively low temperatures. Those parts of the klystron which may be affected by long, continuous service, such as the cathode and collector assemblies, are removable and can be replaced.

● The G-E 15-kw klystron for u-h-f television was developed by Varian Associates, Inc., to General Electric specifications. Six types, including Type GL-6241 illustrated here, serve to cover the entire u-h-f TV band from 470 to 890 megacycles.

Wire, phone, or write for further information! If you wish, a G-E tube application engineer will be glad to call on you. *General Electric Company, Tube Department, Schenectady 5, N. Y.*

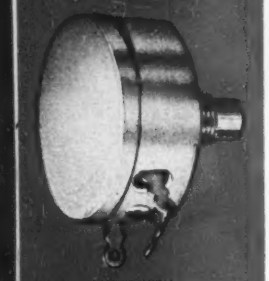
GENERAL ELECTRIC

163-182

TYPE 252, JAN-R-19, Type RA20

2 watt, $1\frac{17}{64}$" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19. Attached Switch can be supplied.

Resistance	RA20, JAN Shaft Type SD		RA20 High Torque, JAN Shaft Type SD	
	CTS Part	JAN-R-19 TYPE	CTS Part	JAN-R-19 TYPE
50±10%	B8079	RA20A1SD500AK	X3496	RA20A2SD500AK
100±10%	W6929	RA20A1SD101AK	L9388	RA20A2SD101AK
250±10%	X3497	RA20A1SD251AK	M9879	RA20A2SD251AK
500±10%	W6931	RA20A1SD501AK	X3498	RA20A2SD501AK
1000±10%	W6932	RA20A1SD102AK	X3499	RA20A2SD102AK
1500±10%	W6933	RA20A1SD152AK	M9809	RA20A2SD152AK
2500±10%	W6934	RA20A1SD252AK	L9103	RA20A2SD252AK
5000±10%	W6935	RA20A1SD502AK	L9104	RA20A2SD502AK
10,000±10%	W6936	RA20A1SD103AK	H8979	RA20A2SD103AK



TYPE 25, JAN-R-19, Type RA30 (May also be used as Type RA25)

4 watt, $1\frac{17}{32}$" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19. Attached Switch can be supplied.

Resistance	RA30, JAN Shaft Type SD		RA30 High Torque, JAN Shaft Type SD	
	CTS Part	JAN-R-19 TYPE	CTS Part	JAN-R-19 TYPE
50±10%	X3502	RA30A1SD500AK	W2837	RA30A2SD500AK
100±10%	X3503	RA30A1SD101AK	X3504	RA30A2SD101AK
250±10%	X3505	RA30A1SD251AK	X3506	RA30A2SD251AK
500±10%	X3507	RA30A1SD501AK	M7566	RA30A2SD501AK
1000±10%	X3508	RA30A1SD102AK	S2444	RA30A2SD102AK
1500±10%	X3509	RA30A1SD152AK	X3510	RA30A2SD152AK
2500±10%	X3511	RA30A1SD252AK	S2736	RA30A2SD252AK
5000±10%	Q1409	RA30A1SD502AK	X3512	RA30A2SD502AK
10,000±10%	X3513	RA30A1SD103AK	R1561	RA30A2SD103AK
15,000±10%	X3514	RA30A1SD153AK	L9107	RA30A2SD153AK

Immediate delivery from stock

JAN-R-94 AND JAN-R-19 TYPE MILITARY VARIABLE RESISTORS

167 types

Preference given to orders carrying military contract number and DO rating. Other JAN items or special items with or without associated switches can be fabricated to your specifications. Please give complete details on your requirements including electrical and mechanical specifications.

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

Designed for use in military equipment subject to extreme temperature and humidity ranges including jet and other planes, guided missiles, tanks, ships and submarines, telemetering, microwave, portable or mobile equipment and all other military communications.

For further information, write for Stock Sheet No. 162

NEW 38-PAGE ILLUSTRATED CATALOG—Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. Write today for your copy.

REPRESENTATIVES

Henry E. Sanders
John B. McClatchy Bldg.
69th & Market St.
Upper Darby, Penna.
Phone: Flanders 2-4420

W. S. Harmon Company
1638 So. La Cienega Blvd.
Los Angeles 35, Calif.
Phone: Bradshaw 2-3321

John A. Green Co.
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Buenos Aires, Argentina
Montevideo, Uruguay
Rio de Janeiro, Brazil
Sao Paulo, Brazil

OTHER EXPORT
Sylvan Ginsbury
8 West 40th Street
New York 18, N. Y.

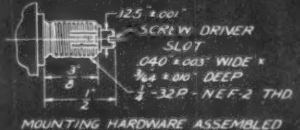
CHICAGO TELEPHONE SUPPLY *Corporation*

specialists in precision mass production of variable resistors

FOUNDED 1896 • ELKHART, INDIANA

SHAFT TYPES AVAILABLE ON STOCK CONTROLS

CTS SHAFT TYPE LT-2



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 1/4 HEX x 1/6
LOCK NUT 1/4 HEX x 1/8
LOCK WASHER #1914A

CTS SHAFT TYPE RE

MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 1/8 HEX x 1/2
LOCK WASHER #1914A

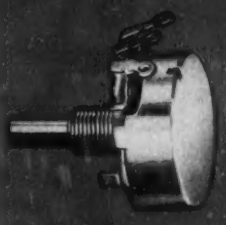
TYPE 65

½ watt 70° C, ¾" diameter miniaturized variable composition resistor.

Resistance	CTS Part CTS Shaft Type RE	CTS Part Locking Bushing CTS Shaft Type LT-2
250±10%	X3516	X3530
500±10%	X3517	X3531
1000±10%	X3518	X3532
2500±10%	X3519	X3533
5000±10%	X3520	X3534
10,000±10%	X3521	X3535
25,000±10%	X3522	X3536
50,000±10%	X3523	X3537
100,000±10%	X3524	X3538
250,000±10%	X3525	X3539
500,000±10%	X3526	X3540
1 Meg±20%	X3527	X3541
2.5 Meg±25%	X3528	X3542

TYPE 95, JAN-R-94, Type RV4

2 watt 70°C, 1¼" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.



Resistance	JAN-R-94 TYPE RV4 JAN Shaft Type SD	JAN-R-94 TYPE RV4 JAN Shaft Type RJ	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	RV4ATSD101A	RV4ATRJ101A	W3160
250±10%	RV4ATSD251A	RV4ATRJ251A	W3161
500±10%	RV4ATSD501A	RV4ATRJ501A	W3162
1000±10%	RV4ATSD102A	RV4ATRJ102A	W3166
2500±10%	RV4ATSD252A	RV4ATRJ252A	W3163
5000±10%	RV4ATSD502A	RV4ATRJ502A	W3164
10,000±10%	RV4ATSD103A	RV4ATRJ103A	W3167
25,000±10%	RV4ATSD253A	RV4ATRJ253A	W3168
50,000±10%	RV4ATSD503A	RV4ATRJ503A	W3169
100,000±10%	RV4ATSD104A	RV4ATRJ104A	W3170
250,000±10%	RV4ATSD254A	RV4ATRJ254A	W3171
500,000±10%	RV4ATSD504A	RV4ATRJ504A	W3172
1 Meg±20%	RV4ATSD105B	RV4ATRJ105B	W3173
2.5 Meg±20%	RV4ATSD255B	RV4ATRJ255B	W3165
5 Meg±20%	RV4ATSD505B	RV4ATRJ505B	W3159

TYPE 45, JAN-R-94, Type RV2

¼ watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.

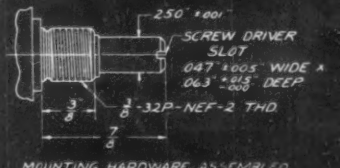
Resistance	RV2, JAN Shaft Type SD CTS Part	JAN-R-94 TYPE	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	A5876	RV2ATSD101A	A5922
250±10%	A5877	RV2ATSD251A	A5923
500±10%	A5878	RV2ATSD501A	A5924
1000±10%	A5879	RV2ATSD102A	A5925
2500±10%	A5880	RV2ATSD252A	A5926
5000±10%	A5881	RV2ATSD502A	A5927
10,000±10%	A5882	RV2ATSD103A	A5928
25,000±10%	A5883	RV2ATSD253A	A5929
50,000±10%	A5884	RV2ATSD503A	A5930
100,000±10%	A5885	RV2ATSD104A	A5931
250,000±10%	A5886	RV2ATSD254A	A5932
500,000±10%	A5887	RV2ATSD504A	A5933
1 Meg±20%	A5888	RV2ATSD105B	A5934
2.5 Meg±20%	A5889	RV2ATSD255B	A5935

TYPE 35, JAN-R-94, Type RV3

½ watt, 1¼" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.

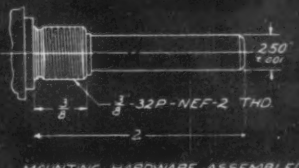
Resistance	RV3, JAN Shaft Type SD CTS Part	JAN-R-94 TYPE	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	A5861	RV3ATSD101A	A5907
250±10%	A5862	RV3ATSD251A	A5908
500±10%	A5863	RV3ATSD501A	A5909
1000±10%	A5864	RV3ATSD102A	A5910
2500±10%	A5865	RV3ATSD252A	A5911
5000±10%	A5866	RV3ATSD502A	A5912
10,000±10%	A5867	RV3ATSD103A	A5913
25,000±10%	A5868	RV3ATSD253A	A5914
50,000±10%	A5869	RV3ATSD503A	A5915
100,000±10%	A5870	RV3ATSD104A	A5916
250,000±10%	A5871	RV3ATSD254A	A5917
500,000±10%	A5872	RV3ATSD504A	A5918
1 Meg±20%	A5873	RV3ATSD105B	A5919
2.5 Meg±20%	A5874	RV3ATSD255B	A5920
5 Meg±20%	A5875	RV3ATSD505B	A5921

JAN SHAFT TYPE SD



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT ⅜ HEX x 1/32
LOCK WASHER #1920A

JAN SHAFT TYPE RJ



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT ⅜ HEX x ⅛
LOCK WASHER #1920A

CTS SHAFT TYPE LT-1
LOCKING BUSHING

MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT ⅜ HEX x ⅛
LOCK NUT ⅜ HEX x ⅛
LOCK WASHER #1920A

*Quality Controlled**
TO THE HIGHEST STANDARDS OF THE INDUSTRY

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plasticord-plasticote WIRES and CABLES

*Quality Control works 2 ways at CHESTER

It's a fact and here's why! First, Chester quality control engineers certify every phase of manufacture from raw material to finished product packed for shipment. No detail is too small or unimportant to merit their full attention. Second, quality in turn governs production — not a single foot of Chester wire or cable is ever "hurried through" to meet a shipping date or heavy schedule. Extra shifts, not faster production is the method used to break bottlenecks at Chester.

This two way quality control is just one of many important reasons why electrical and electronic men, in increasing number, specify Chester wire and cable for an extra measure of reliability. Why not check your requirements with Chester today.

FOR EVERY APPLICATION —

JAN-C-76 • 80°-90°-105°C

Hook-Up Wire • Shielded Wire and Cable Flexible Cords • Coaxial Cable • Television Lead-In Cable • Gas Tube High Tension Cable • Oil Burner Ignition Cable • Blasting Wire • Thermostat Cable • Bell and Office Wire • TW Building and Fixture Wire

JAN-C-76 SRIR

UL APPROVED 105°C

JAN-C-76 SRRF

UL APPROVED 90°C

JAN-C-76 SRHV

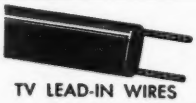
UL APPROVED 80°C

JAN-C-76 WL

SHIELDED WIRES & CABLES

FLEXIBLE CORD

INSTRUMENT WIRES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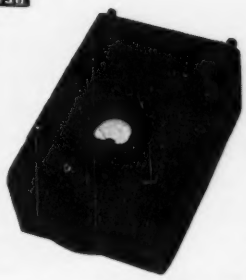
CHESTER, NEW YORK

MANUFACTURERS OF QUALITY WIRE AND CABLE FOR EVERY ELECTRICAL AND ELECTRONIC REQUIREMENT

Speed up analysis with these Brush instruments

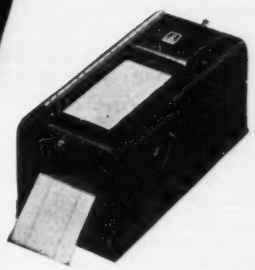


Direct-coupled Amplifier
Model BL-932

AMPLIFIES VERY LOW VOLTAGES. The Brush Direct-coupled Amplifier features high sensitivity and low drift. When used in conjunction with the Brush Magnetic Oscillograph, it gives one chart millimeter deflection per millivolt input. Design features reduce effects of power line fluctuation. Zero signal drift not more than one chart millimeter per hour. Frequency response essentially uniform from d-c to 100 cycles.

When used with the Brush Magnetic Oscillograph, the Amplifier can be used to record phenomena previously requiring the use of complicated intermediate equipment. Analysis of static or dynamic conditions involving either high or low signal strength is simplified and speeded with this equipment. Below, it is shown recording time constants of a reactor to provide a saturation curve.

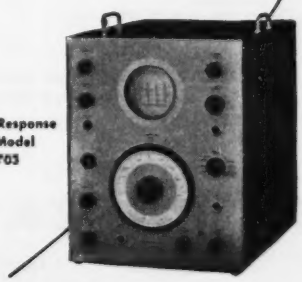
PROVIDES IMMEDIATE RECORDING. The Brush Magnetic Oscillograph, used with the proper Brush Amplifier, makes a direct chart recording of physical phenomena which is immediately available. Either direct inking or electric stylus models available. Gear shift provides chart speeds of 5, 25, and 125 mm per second. An auxiliary chart drive is available for speeds of 50, 250, and 1250 mm per hour. Accessory equipment provides event markers where an accurate time base is required, or where it is desirable to correlate events. Photo shows two-channel model for recording of two phenomena simultaneously.



Direct-writing Two-Channel
Magnetic Oscillograph Model BL-202

CHECKS FREQUENCY RESPONSE QUICKLY. The Frequency Response Tracer permits visual examination of frequency response characteristics of radio receivers, amplifiers, transmission lines, filters. Electro-acoustic investigation of loudspeakers, microphones, and telephones can be made. Frequency range is 20 to 20,000 cycles, logarithmic scale. Continuous motor drive scans entire frequency range in 8 seconds.

Write for free copy of Bulletin 618 giving details on these Brush instruments. The Brush Development Company, Dept. K-24, 3405 Perkins Ave., Cleveland 14, Ohio. In Canada: A. C. Wickman Limited, Box 9, Station N, Toronto.



Frequency Response
Tracer Model
BL-4703

PUT IT IN WRITING WITH A BRUSH RECORDING ANALYZER

THE Brush DEVELOPMENT CO.

PIEZOELECTRIC CRYSTALS AND CERAMICS • MAGNETIC RECORDING
ACOUSTIC DEVICES • ULTRASONICS • INDUSTRIAL & RESEARCH INSTRUMENTS

improve your product with – MYCALEX

THE OUTSTANDING **LOW LOSS HIGH FREQUENCY INSULATION** FOR OVER A QUARTER OF A CENTURY

MYCALEX is a highly developed glass-bonded mica insulation backed by a quarter-century of continued research and successful performance. Both pioneer and leader in low-loss, high frequency insulation, **MYCALEX** offers designers and manufacturers an economical means of attaining new efficiencies, improved performance. The unique combination of characteristics that have made **MYCALEX** the choice of leading electronic manufacturers are typified in the table for **MYCALEX** grade 410 shown below. Complete data on all grades will be sent promptly on request.

MYCALEX is efficient, adaptable, mechanically and electrically superior to more costly insulating materials

- **PRECISION MOLDS TO EXTREMELY CLOSE TOLERANCE**
- **READILY MACHINEABLE TO CLOSE TOLERANCE**
- **CAN BE TAPPED THREADED, GROUND, SLOTTED**
- **ELECTRODES, METAL INSERTS CAN BE MOLDED-IN**
- **ADAPTABLE TO PRACTICALLY ANY SIZE OR SHAPE**

MYCALEX is available in many grades to exactly meet specific requirements

CHARACTERISTICS OF MYCALEX GRADE 410

Meets all the requirements for Grade L-4A, and is fully approved as Grade L-4B under Joint Army-Navy Specification JAN-1-10

Power factor, 1 megacycle	0.0015
Dielectric constant, 1 megacycle	9.2
Loss factor, 1 megacycle	0.014
Dielectric strength, volts/mil	400
Volume resistivity, ohm-cm	1×10^{13}
Arc resistance, seconds	250
Impact strength, Izod, ft.-lb/in. of notch	0.7
Maximum safe operating temperature, °C	350
Maximum safe operating temperature, °F	650
Water absorption % in 24 hours	nil
Coefficient of linear expansion, °C	11×10^{-6}
Tensile strength, psi	6000

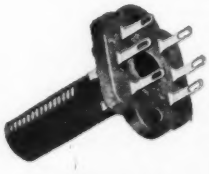
MYCALEX is specified by the leading manufacturers in almost every electronic category

Mycalex 410 Tuning Coil Form

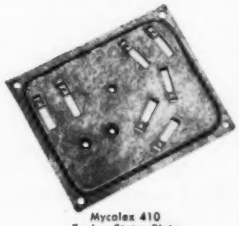
Mycalex 410 Tuning Switch Plate

Mycalex 410 Terminal Base and Cap Assembly for Fire Detection Equipment

Mycalex 410 Rotary Switch Stator



Mycalex 410 Solenoid Type Coil Form



Mycalex 410 Tuning Stator Plate

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG. U.S. PAT. OFF.

MYCALEX CORPORATION OF AMERICA

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SORENSEN *electronically*

REGULATES AND CONTROLS

HIGH-VOLTAGE **DC** LOW-CURRENT

SORENSEN'S EXPANDED LINE OF B-SUPPLYS NOW INCLUDES THIS NEW MULTI-RANGE DUAL SUPPLY.

Many users of Sorensen Nobatrons* and AC Regulators are unaware that the standard Sorensen line includes a wide range of "B-Nobatrons" — high voltage, low-current DC sources.

Are you familiar with the number of units in the line? Two of them — models 360BB and 520BB — are low-cost units for those not requiring outputs adjustable down to zero, but which can be paralleled for higher current requirements. The other models are highly flexible, all-purpose laboratory instruments. All of them provide voltage and current well in excess of the specifications given below (these "plus values" are shown graphically in the new Sorensen DC catalog).

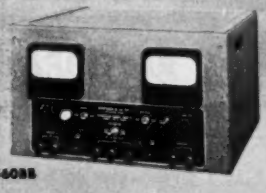
You owe it to yourself to get acquainted with these Sorensen B-NOBATRONS. You'll find they are reasonably priced — surprisingly so — yet in all ways live up to the Sorensen reputation for sound engineering, quality construction, dependable operation. Write for information.

*Reg. U.S. Pat. Off. by Sorensen & Co., Inc.

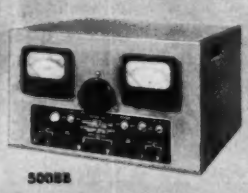
MODEL 350-B SPECIFICATIONS

INPUT	105 - 125 VAC, 50 - 60 ~, 1Ø.
OUTPUT	1. 175-350 VDC @ 0-60 Ma simultaneously from two independently adjustable outlets. 2. 175-350 VDC @ 0-120 Ma from one outlet. 3. 0-175 VDC @ 0-60 Ma from one outlet. 4. 6.3 VAC @ 3.5 amps., C.T., unregulated.
OUTPUT REGULATION	±1.0%
RIPPLE	10 mv
SIZE	13" x 7½" x 8"

325BB

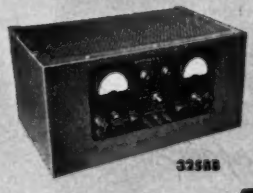


360BB



500BB

1000BB



325BB

360BB

MODEL NO.	325BB	360BB	520BB	560BB	500BB	1000BB
Output voltage	0-325	175-360	200-500	0-500	0-500	200-1000
Output current	0-125 Ma	0-120 Ma	0-200 Ma	0-200 Ma	0-300 Ma	0-500 Ma
Output voltage, bias	0-150	.....	.....	0-150	0-150	.....
Output current, bias	0-5 Ma	.....	.....	0-5 Ma	0-5 Ma	.....
Ripple	10 mv	10 mv	10 mv	10 mv	10 mv	20 mv
Low AC voltage (center tapped, unregulated)	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 10 amp.	.....

Regulation accuracy: ±0.5% (±1% in 360BB and 520BB)
Input: 105-125 volts AC, 50-60 cycles, single phase.
Models 325BB, 560BB, 500BB and 1000BB are metered.
Units are normally self-contained. All can be provided with a front panel for rack mounting.

SPECIFY **SORENSEN**

For Complete Information Write

SORENSEN & COMPANY, INC.

375 Fairfield Avenue Stamford, Conn.

AMAZING *NEW* IMPREGNANT

makes good capacitors better

by permitting higher operating voltages

E-therm impregnated capacitors are now available in production quantities. E-therm is a unique new impregnating material developed and compounded by Sangamo. E-therm impregnated capacitors far exceed the requirements of JAN Specifications. E-therm possesses exceptionally high thermal stability and superior electrical characteristics. E-therm impregnated capacitors mean—higher operating temperatures—lower power factor—higher resistance—longer life.

E-therm

DEVELOPED BY SANGAMO

Operating temperature 125°C

E-therm is another example of advanced Sangamo engineering. Continued research and development of new products enables Sangamo to meet the existing and future needs of the electronic industry. ***For additional information about E-therm, write for Engineering Bulletin No. 104.***

Those who know

...choose Sangamo

SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

SC52-9

FOR LOW-COST WIDE RANGE FREQUENCY COVERAGE 5 cps to 500 kc

DISTORTION 1%

CALIBRATION ±2%

AMPLITUDE ±1 db

HUM 0.1%

FIXED SYNC. OUTPUT

KROHN-HITE—Model 430-A—Audio Oscillator

only $145.00 For Immediate Delivery

Specifications

FREQUENCY RANGE: 4.5 to 520,000 cps., continuously variable in five decade bands.

FREQUENCY DIAL: Single scale, direct reading, calibrated logarithmically from 45 to 520 on a 6" scale.

FREQUENCY ACCURACY: Calibration ±2%, drift including initial warm-up is less than 2%, drift with ±10% change in line-voltage is less than ±0.2%.

OUTPUT:

VOLTAGE: 10 volts rms. maximum, adjustable continuously by a logarithmic output level control with a scale calibrated from .01 to 10 volts. Additional fixed output 10 volts rms.

LOAD: Minimum 1000 ohms.

AMPLITUDE: Varies less than ±1 db over the entire frequency range from 4.5 to 520,000 cps. and less than ±0.5 db for ±10% change in line voltage.

DISTORTION: Less than 1% at any output level setting.

HUM: Less than 0.1% at any output level setting.

INPUT POWER: 105-125 volts, 50-60 cps., 45 watts.

TUBE COMPLEMENT: Furnished with instrument: 2-6AC7, 2-6V6-GT, 1-6AX5-GT.

FORM: Aluminum cabinet, overall dimensions 12" wide, 7" high, 8" deep. Weight 15 lbs.

Write for free catalog.

KROHN-HITE INSTRUMENT COMPANY
580 MASSACHUSETTS AVENUE
DEPT. E, CAMBRIDGE 39, MASS., U.S.A.

OTHER INSTRUMENTS

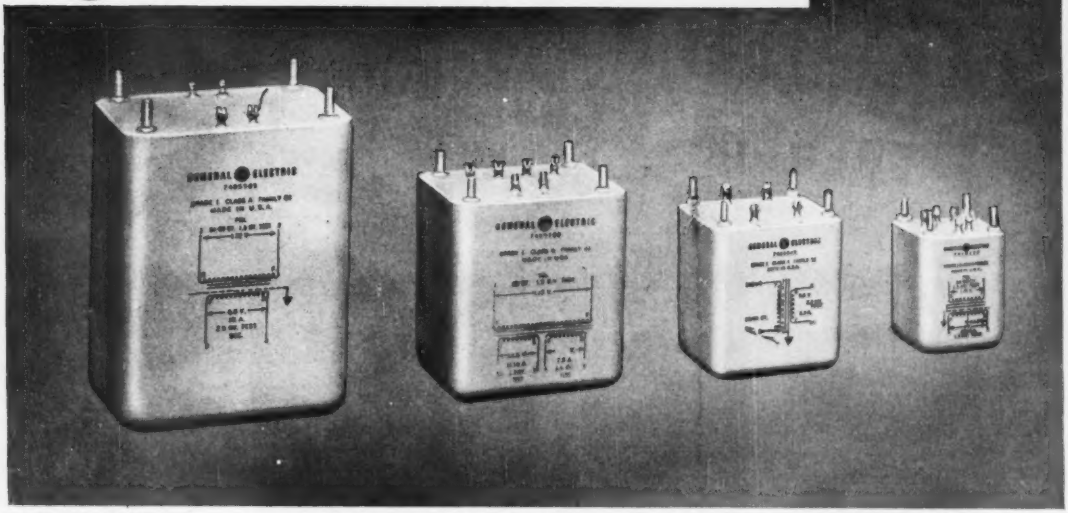
FILTERS

Model	Type	Frequency Range	Noise & Hum	Price
310-A	Band-Pass	20 cps to 200 kc	3 mv	$275.00
330-A	Band-Pass	.02 cps to 2 kc	0.1 mv	$450.00
	Band-Pass	0.2 cps to 20 kc	0.1 mv	$450.00
340-A	Servo	.01 cps to 100 cps	10 mv	$350.00
350-A	Rejection	.02 cps to 2 kc	0.1 mv	$450.00
360-A	Rejection	20 cps to 200 kc	5 mv	$275.00

OSCILLATORS

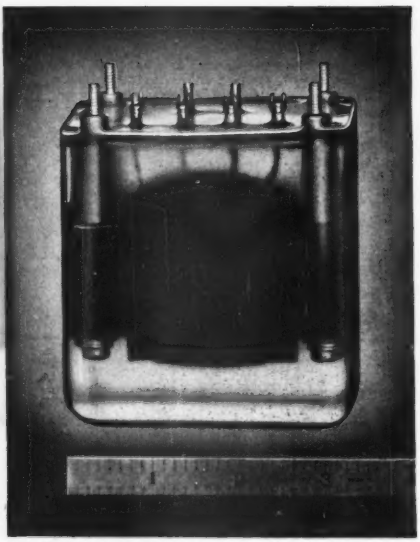
Model	Frequency Range	Distortion	Output	Price
400-A	.009 cps to 1.1 kc	1%	25 mw/10 v	$350.00
410-A	.02 cps to 20 kc	1/4%	10 mw/5 v	$950.00
420-A	.35 cps to 52 kc	1%	25 mw/10 v	$290.00
400-C	.009 cps to 1.1 kc	1%	100 mw/10 v	$375.00
420-C	.35 cps to 52 kc	1%	100 mw/10 v	$325.00
440-A	.01 cps to 100 kc	1/10%	100 mw/10 v	$450.00

CAST-PERMAFIL TRANSFORMERS



NEW LINE of G-E cast-permafil electronic transformers does away with the need for hermetically sealed metal enclosures. Cast construction, lighter weight and smaller size offer the designer greater flexibility in many types of electronic designs.

New G-E designs available



SIMPLER CONSTRUCTION of G-E cast-permafil transformers shows up dramatically in this model cast in clear resin. Note how the resin anchors the terminals, eliminating need for a steel enclosure.

Smaller, Lighter Cast-Permafil Transformers Designed to MIL-T-27 "Specs"—Need No Fungus-Proof Coatings

Interchangeable with existing hermetic designs, General Electric's new line of cast-permafil transformers—solventless resin type—offer many design advantages.

MOISTURE PROOF—"Cast-in" construction seals transformer permanently against moisture as required in MIL-T-27 Grade 1 Performance Specifications. Permafil forms a tough, shatter-resistant, solid casing.

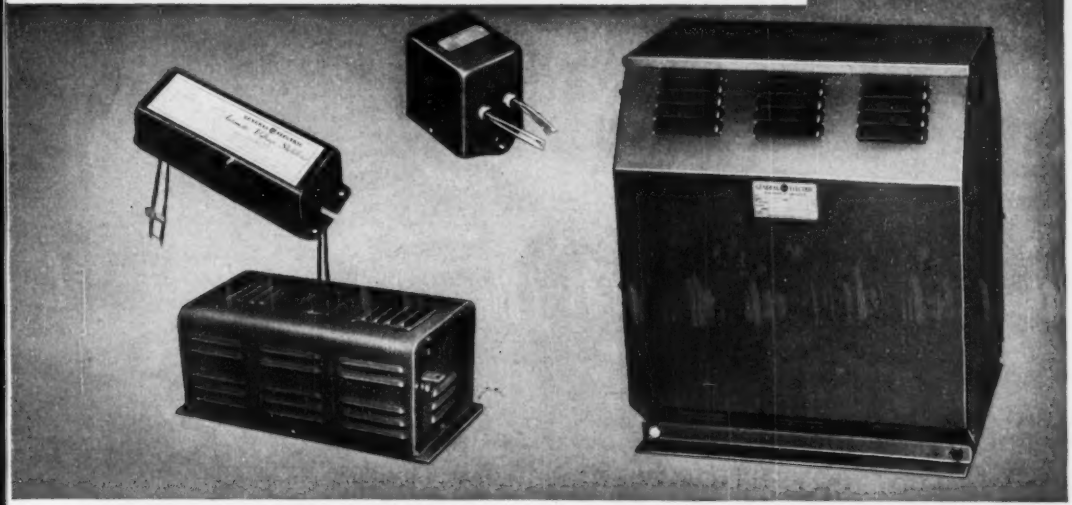
AVERAGE 20% SMALLER because they eliminate metal enclosures, and because their terminals can be anchored directly in permafil mixture, the new G-E cast-permafil transformers are smaller and lighter weight. The complete line—which includes 11 sizes, 9 of them in two heights—averages about 20% smaller than previous models.

MORE FLEXIBLE with fewer machined and punched parts, greater flexibility in design and construction is possible. Terminal arrangements can be varied. Color can be "built in" by adding pigment to the permafil mixture. Permafil makes fungus-proof coatings unnecessary.

ACCELERATED LIFE TESTS indicate that G-E cast-permafil transformers will stand up as long as Class A hermetics at 105 C. And at 130 C. ultimate, they have an expected life of 1000 hours or more.

For complete information on the application, ratings and availability of G-E cast-permafil transformers, write to ***Section 411-102, General Electric Company, Schenectady 5, N. Y.***

AUTOMATIC VOLTAGE STABILIZERS



NEW LINE rated from 15 VA to 5000 VA. Stabilizers feature totally enclosed, single-core construction, reduced weight and greater flexibility for designs involving voltage ratios other than 1:1. A wide range of voltage correction is offered.

for electronics use

Lighter G-E Automatic Voltage Stabilizers Feature Inherent Input-Output Isolation—More Voltage Ratios

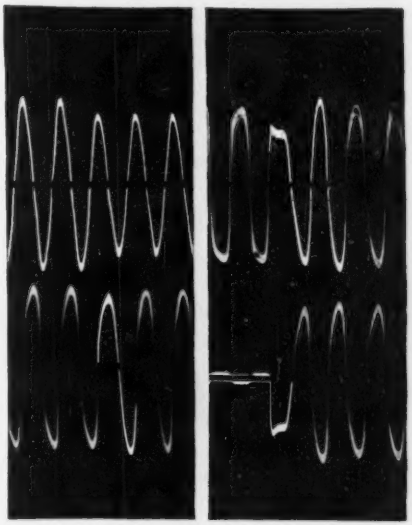
SINGLE-CORE CONSTRUCTION in General Electric's new standard line of 60-cycle automatic voltage stabilizers provides inherent input-output isolation—eliminates the need for an additional isolating transformer. You get substantial weight reduction over previous units in the 1000 to 5000 VA ratings.

TOTALLY ENCLOSED construction of the new design cuts down stray magnetic fields—allowing use near sensitive electronic devices like oscilloscopes.

VOLTAGE RATIO FLEXIBILITY has also been increased in the new line. Standard stabilizers—with ratings from 1000 VA through 5000 VA—are provided with series multiple input and series multiple output.

IN ADDITION, these new units offer a wide-range of voltage correction, plus rapid stabilization, ease of installation and maintenance-free operation.

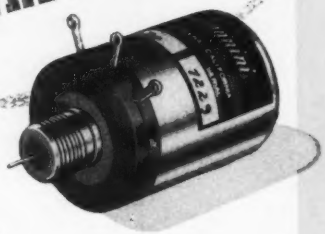
For further information on this new line of standard automatic voltage stabilizers call your local G-E distributor. Or write for bulletin GEA-5754 G-E Automatic Voltage Stabilizers. *Section 411-102, General Electric Co., Schenectady 5, N. Y.*



RAPID RESPONSE of G-E Automatic Voltage Stabilizers. *Left:* Stabilization within 1½ cycles as input drops from 130 to 95 volts. *Right:* Stabilization in 2 cycles as load current jumps from 0 to full load.

GENERAL ELECTRIC

AVAILABLE FOR IMMEDIATE DELIVERY!



MICROTORQUE* POTENTIOMETER

You are now assured immediate delivery of the Microtorque* Potentiometer. As a new service to customers, a complete stock of resistance values as listed, is maintained to assure immediate delivery for prototypes, experimental work or emergency production. The Microtorque* is the solution where remote indicating, low torque (.003 oz. in.), jewel bearings and instrument quality are required.

Other Giannini Potentiometers that are available on special order; soon to be stocked.

SPECIFICATIONS

LINEARITY: ± 0.5% of total resistance.

MAXIMUM OPERATING SPEED: 100 rpm.

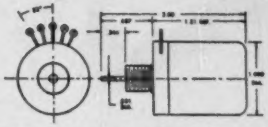
ACCELERATION: Will withstand 50G steady state acceleration in best axis.

VIBRATION: Will withstand 0.06" double amplitude sinusoidal vibration from 10 to 55 cps in best axis.

AMBIENT TEMPERATURE: Will function mechanically from −54° C. to + 71° C.

MOMENT OF INERTIA: 2 x 10−⁴oz-in.² (approx.)

TEMPERATURE COEFFICIENT OF RESISTANCE: .0006/° C. Max.



Following Microtorques* are available from stock in quantities of six or less:

RES. OHMS	STARTING TORQUE IN-OZ.	TURNS OF WIRE TYPE 2	TYPE 9	CURRENT** MA.	PRICE***
250	.006	350	450	57	$45.00
1,000	.004	500	650	28	$40.00
2,000	.004	700	750	20	$40.00
5,000	.003	900	1200	14	$40.00
10,000	.003	1,000	1300	10	$40.00
25,000	.003	1,000	1300	7	$45.00

**Must be de-rated for ambient temperature over 50° C

***Prices apply to quantities of six or less. For quotation on larger quantities or special types, please write

Above Microtorques* are available in the following two types Type 2: 270° ± 10° Electrical Rotation, Mechanical Rotation Limited by internal stops

Type 9: 354° Min. Electrical Rotation, Mechanical Rotation Continuous Brush does not short ends of coil

Giannini also produces potentiometers of various types, including non-linear functions, and tapped windings

Syncromount
Linear and functional outputs. Ball bearings; ¼" shaft, 0.1 oz. in. torque. 500 to 100,000 ohms. 1.125" diameter x 1.16" long.
Rectipot
Straight-line motion along axis. Linear or functional outputs. 200 to 60,000 ohms. 5 sizes, 1" diameter from 2.33 to 6.54" long.
Syncromount JUNIOR
Linear and functional outputs. .078 shaft — miniature ball bearings. ⅞" diameter x 1" long. .01 oz. in. torque. 500 to 100,000 ohms.

*MICROTORQUE—*T.M. REG. 1952

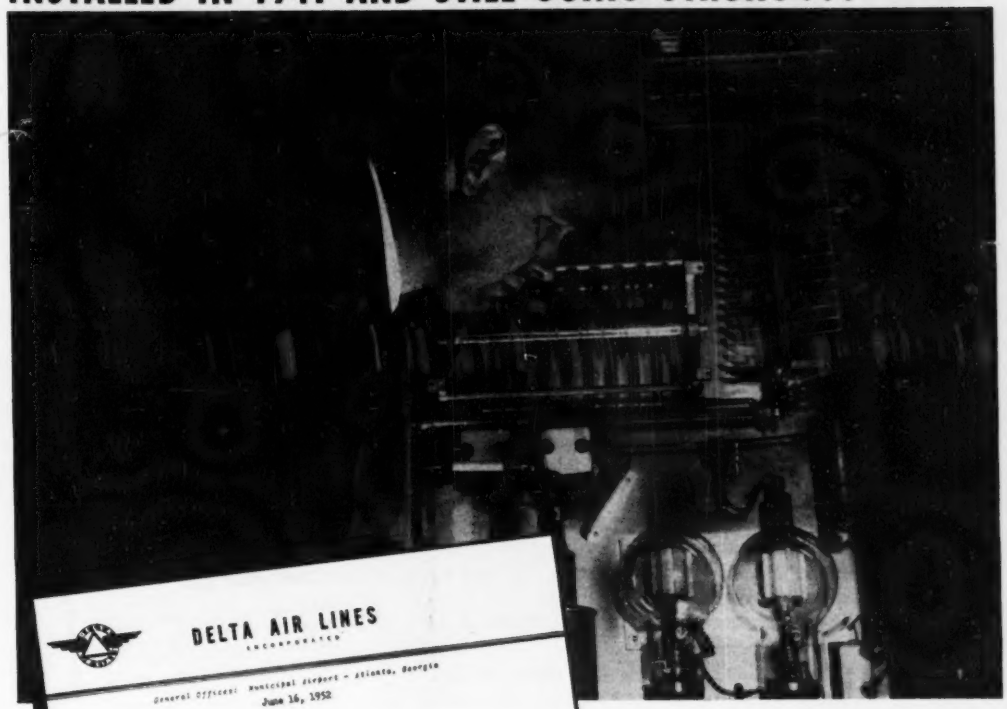
Foremost manufacturer of toroidally-wound potentiometers. Where linearity, stability, rigidity, power dissipation and precision are required, toroid windings are outstanding performers.

Giannini

INSTRUMENT QUALITY
POTENTIOMETERS

G. M. GIANNINI & CO., INC. PASADENA 1, CALIF. EAST ORANGE, NEW JERSEY

INSTALLED IN 1941 AND STILL GOING STRONG . . .



DELTA AIR LINES
INCORPORATED

General Offices: Municipal Airport - Atlanta, Georgia

June 16, 1952

Eitel-McCullough, Inc.
San Bruno, California

Gentlemen:

From time to time in your advertisements, I have noticed reports of Eimac tubes that have served an exceptionally long life. You may be interested in the 450TL statistics at our Atlanta, Georgia, station.

The transmitter in this station uses eight 450TL's in RF service. Of the eight, seven have been in operation since the transmitter was installed in October, 1941. Our Dallas, Texas, transmitter installed about the same time still has five of its original 450TL tubes.

The most important factor in the operation of an airline is safety. This is determined largely by the dependability of the equipment it uses. Delta Air Lines, like any business operating on a sound financial basis, must obtain the most value for every dollar spent. It would appear, in the case of our radio tubes as well as many other products, that the two factors, safety and economy, go hand in hand.

Very truly yours,

DELTA AIR LINES, INC.

J. B. Kramer
Supervisor of Ground Radio

JBK:dk

. . . reports

DELTA AIR LINES of EIMAC Tubes

This story of dependability through more than a decade of day in, day out operation is typical of what leading users of electronic equipment are finding whenever Eimac tubes are employed. Write our application engineering department for information about the complete line of Eimac transmitting power tubes.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Eimac TUBES

Extra Protection

FOR LEADS AND WIRE CONNECTIONS

at No Extra Cost

with DIEFLEX®

"Vinylglas" Tubings and Sleevings

You can knot it, twist it, heat or cool it . . . and it won't lose its extreme flexibility or exceptional dielectric strength. Yes, you get all these extra protective qualities just by specifying Dieflex "Vinylglas" vinyl-coated glass tubing or sleeving. Yet it is as inexpensive as ordinary cotton and glass base materials!

Think of it! Really tough assembly and operating conditions don't harm this rugged insulation. It remains as flexible and sound as ever, even after creasing, rubbing, or heating. Dieflex "Vinylglas" tubing or sleeving is available in sizes No. 24 through 1¼" in a complete range of heat resistant colors. Grades A-1, B-1, C-1, and C-2 can be supplied.

Test Dieflex "Vinylglas" vinyl-coated glass tubing or sleeving yourself. You'll be amazed at this combination of high protective characteristics and low prices. Ask your nearest IMC office for samples, literature, and more information, today.

Knot it . . .
no cracking or loss of dielectric
150° C
Heat it . . .
retained top flexibility and dielectric after being tested for 100 hours at 150° C
Cool it . . .
excellent low temperature flexibility
Push it Back . . .
pushes back on wire easily —even in higher grades

OTHER DIEFLEX PRODUCTS

Grades A-1, B-1, C-1, C-2, and C-3 varnished cotton or rayon tubings or saturated cotton or rayon sleevings

Heavy Wall saturated cotton sleevings

Grades A-1, B-1, C-1, C-2, and C-3 varnished glass tubings or saturated glass sleevings

Grades A-1, C-1, C-2, and C-3 silicone varnished glass tubings or silicone saturated glass sleevings

Dieflex Products Are Guaranteed to Meet Or Surpass All Applicable NEMA and ASTM Standards

INSULATION MANUFACTURERS CORPORATION

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563 W. Washington Blvd.
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*CLEVELAND 14
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101 Heinz Court
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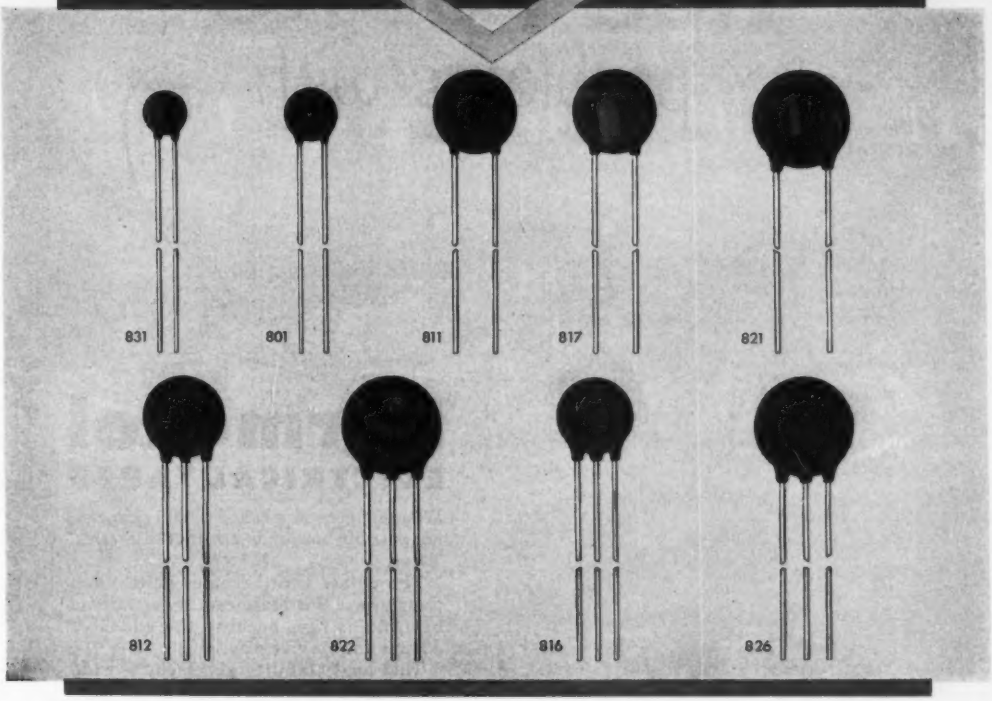
ELECTRICAL IMC INSULATION

ERIE

DISC CERAMICONS®



ERIE offers a complete line of Disc Ceramicons in By-Passing, Temperature Compensating, and High Voltage types. A distinguishing feature of Erie Disc Ceramicons is high capacity—up to .02 mfd—in extremely compact size. Also, High Voltage Disc Ceramicons are available in ratings up to 8000 volts D. C. working. Basic diameter sizes are 5/16", 3/8", 19/32", and 3/4" maximum.

They are amazingly easy to install in small spaces . . . they simplify soldering and wiring operations, and speed up the assembly line. Erie Disc Ceramicons consist of round flat dielectrics with fired on silver plates, and leads of tinned copper wire firmly soldered to silver electrodes. The units are given a protective coating of phenolic and vacuum wax impregnation. Dual discs are available in both shielded and non-shielded construction.

Such simplicity of construction results in low series inductance and unusual efficiency in high frequency by-passing.

Write for complete information regarding your specific needs, and samples.

ERIE TRADE MARK

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

Main Offices: **ERIE, PA.**

Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Buffalo, N. Y. • Chicago, Ill. Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.

Factories: **ERIE, PA.** • **LONDON, ENGLAND** • **TORONTO, CANADA**

solve your "Hot Potato" problems with

®Permacel ELECTRICAL TAPES

What happens to a baked potato skin cannot possibly happen to **PERMACEL** Electrical Tapes.

The potato skin becomes brittle and peels away. But **PERMACEL**, under intense heat, holds fast, because the adhesive doesn't flow or give way.

This heat stability gives you a wide safety factor in "bakes"...cuts down "pop-ups"...reduces rejections and rework.

PERMACEL Electrical Tapes lower production costs.

There's a **PERMACEL** tape for every job. High-voltage Insulation, Noncorrosiveness, Heavy-duty Holding, Quick Anchoring, Snug Conformance, High-heat Resistance—or what have you? Pass your "hot potatoes" to us. We have the products to handle them.

INDUSTRIAL TAPE CORPORATION
NEW BRUNSWICK, N. J.

Makers of TEXCEL® Cellophane Tape, and a complete line of pressure-sensitive tapes for industry.

MICROTRAN®

hermetically sealed transformer

available as stock items

These ruggedized military type units were developed to meet demands of a growing miniaturization program.

All units are available from stock in hermetically sealed cans, although open frame units may be ordered. Open frame units are Epoxy Resin impregnated to provide thorough protection from adverse climatic conditions and are supplied with flexible 3" color coated leads.

Also available on special order for MIL applications are standard MIL type cases.

Open Frame Construction

MINIATURE TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED.	SECONDARY IMPED. Ω	RESPONSE ±2 db. (C.P.S.) MAX. LEVEL 10 db.	LIST PRICE
MI	TF1A10YY	Mike pickup or line to 1 grid	50, 200, 500	50,000	20-20,000	$15.40
M2	TF1A10YY	Mike pickup or line to 2 grids	50, 200, 500	50,000	20-10,000	15.40
M3	TF1A10YY	Dynamic mike to 1 grid	7.5, 30	50,000	20-20,000	14.30
M4	TF1A15YY	Single plate to 1 grid	15,000	60,000	20-13,000	12.10
M5	TF1A15YY	Single Plate to 1 grid	15,000 4MA.D.C.	60,000	200-20,000	12.10
M6	TF1A15YY	Single plate to 2 grids	15,000	95,000	20-15,000	14.30
M7	TF1A15YY	Single plate to 2 grids	15,000 4MA.D.C.	95,000	200-20,000	14.30
M8	TF1A13YY	Single plate to line	15,000	50, 200, 500	20-20,000	15.40
M9	TF1A13YY	Single plate to line	15,000 4MA.D.C.	50, 200, 500	150-20,000	15.40
M10	TF1A13YY	Push pull plates to line	30,000 ohms P.-P.	50, 200, 500	30-50,000	15.40
M11	TF1A10YY	Crystal mike to line	50,000	50, 200, 500	20-20,000	15.40
M12	TF1A16YY	Mixing and matching	50, 200	50, 200, 500	30-40,000	14.30
M13	TF1A20YY	Reactor 300 HYS. - No D.C.: 50 HYS - 3MA. D.C.		6,000 ohms D.C. res		11.00
M14	TF1A10YY	50: 1 mike or line to 1 grid	200	1/2 Megohm	80- 3,000	15.40
M15	TF1A15YY	10: 1 single plate to 1 grid	15,000	1 Megohm	100-2,500	15.40

SUB MINIATURE TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED. Ω	SECONDARY IMPED. Ω	RESPONSE ±2 db. (C.P.S.) MAX. LEVEL 0 db.	LIST PRICE
SM1	TF1A10YY	Input	200, 50	250,000, 62,500	80-10,000	$12.90
SM2	TF1A15YY	Interstage 3:1	10,000	90,000	100-10,000	12.90
SM3	TF1A13YY	Plate to line	10,000(3MA.)-25,000(1.5MA.)	200, 500	150-10,000	12.90
SM4	TF1A13YY	Output	30,000 1MA.D.C.	50	70-10,000	12.90
SM5	TF1A20YY	Reactor 50 HY at 1 mil D.C.	4,000 ohms.D.C. res.			10.90
SM6	TF1A13YY	Output	100,000 .5MA.D.C.	60	100-10,000	12.90

MICRO MINIATURE TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED. Ω	SECONDARY IMPED. Ω	RESPONSE ±2 db (C.P.S.) MAX. LEVEL 0 db.	LIST PRICE
MM1	TF1A10YY	Input	200, 50	250,000, 62,500	200-10,000	$12.90
MM2	TF1A15YY	Interstage 3:1	10,000	90,000	150-10,000	12.90
MM3	TF1A13YY	Plate to line	10,000(3MA.)-25,000(1.5MA.)	200, 500	150-10,000	12.90
MM4	TF1A13YY	Output	30,000 1MA.D.C.	50	150-10,000	12.90
MM5	TF1A20YY	Reactor 50 HY at 1 mil D.C	3,500 ohms.D.C. res.			10.90
MM6	TF1A13YY	Output	100,000 .5MA.D.C.	60	200-10,000	12.90

TRANSISTOR TRANSFORMERS

PART NO.	MIL TYPE	APPLICATION	PRIMARY IMPED.	SECONDARY IMPED.	LIST PRICE M	LIST PRICE SM & MM
*T1	TF1A10YY	Input-Line to emitter	500	500	$14.30	$14.15
*T2	TF1A10YY	Input-Hi impedence mike to emitter	50,000	500	15.70	14.15
*T3	TF1A15YY	Interstage-collector to emitter	50,000	500	15.70	14.15
*T4	TF1A13YY	Output-collector to line	50,000	500	15.70	14.15
*T5	TF1A13YY	Output-collector to speaker	50,000	8	14.50	14.15

* Add M Prefix to indicate miniature size, SM for sub-miniature size, MM for micro-miniature size. Size to be used depends on D.C. current, frequency response and power output requirements. Write for full details.

Immediate delivery of stock items!

Our circuit design department can assist you in your miniaturization problems. Our recent developments of HI "Q" audio transformers for single frequency applications have permitted substantial reduction in equipment complexity.

Write for Catalogue M and name of nearest representative.

CREST

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Whitehall Building, Far Rockaway 91, N. Y.

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for products of precision and dependability

Aircraft Instruments and Controls • • • Miniature AC Motors for Indicating and Remote Control Applications • • • Optical Parts and Optical Devices Radio Communications and Navigation Equipment

Today, Kollsman works without pause toward the fulfillment of America's defense needs. And to our nation's research scientists, the skill, ingenuity and creative drive of Kollsman Research Laboratories are available for the solution of instrumentation and control problems.

KOLLSMAN INSTRUMENT CORPORATION

ELMHURST, NEW YORK — GLENDALE, CALIFORNIA

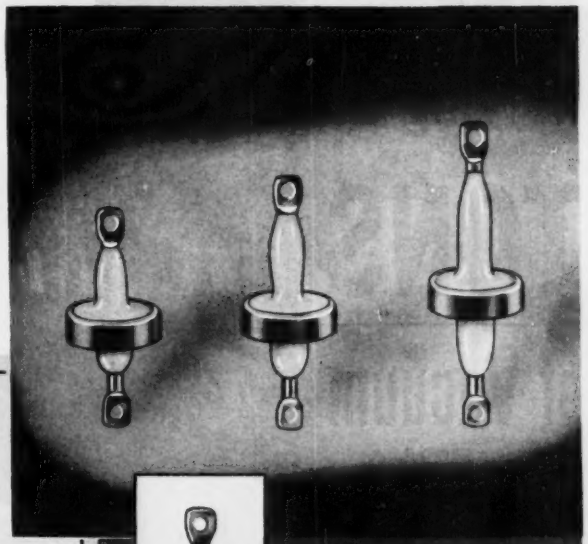
SUBSIDIARY OF *Standard* COIL PRODUCTS CO. INC.

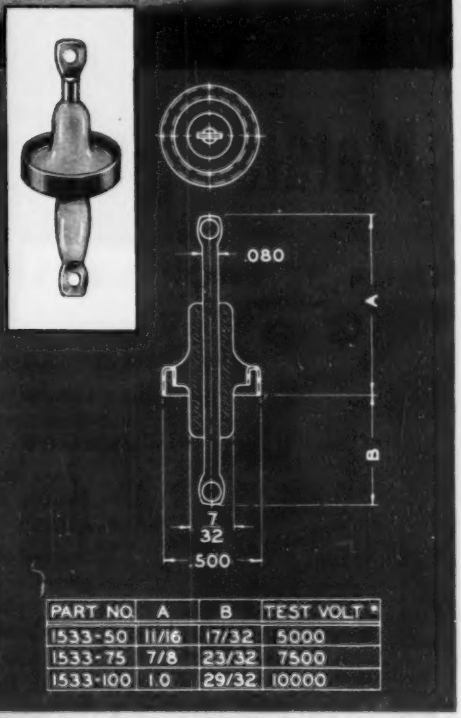
TAKES UP TO 10,000 VOLTS TEST

New

HIGH VOLTAGE TERMINAL

RUGGED FOOLPROOF





PART NO.	A	B	TEST VOLT *
1533-50	11/16	17/32	5000
1533-75	7/8	23/32	7500
1533-100	1.0	29/32	10000

HERMETIC's new high voltage terminal is a glass-metal header that can take up to 10,000 volts and yet occupies only ½" diameter on the mounting surface. It is amazingly rugged and will insure foolproof operation because of the diaphragm construction of the mounting. It is available with solid or tubular center conductors. Applications are many, among which are its use in transformers, choke coils, capacitors and pulsed circuits.

What are your requirements in hermetic sealing? Contact HERMETIC, the one and only dependable source of supply, and be sure that your problems, too, will be solved to your complete satisfaction.

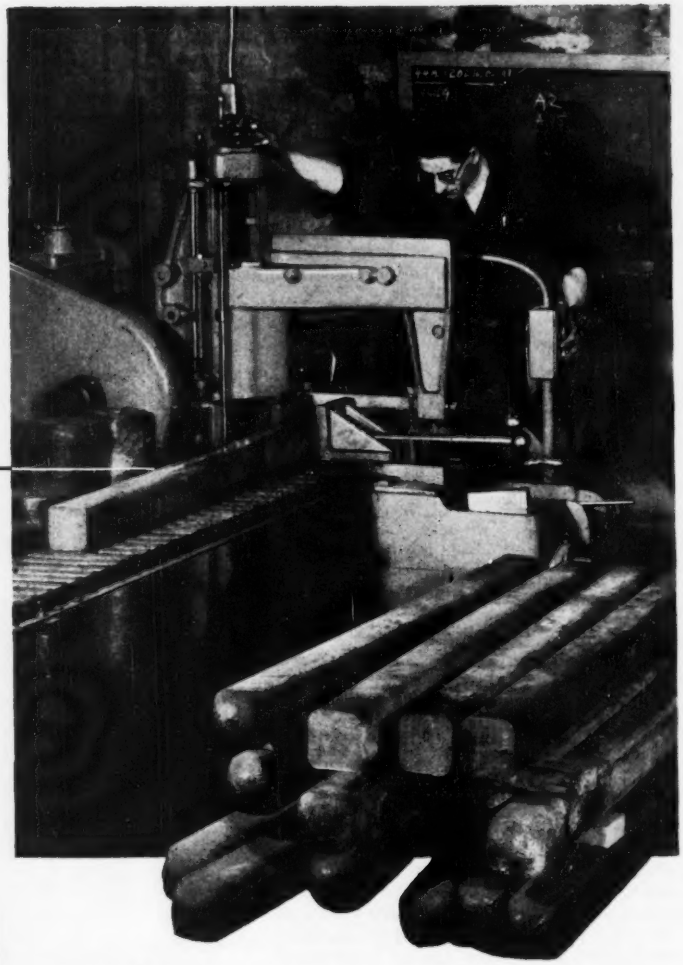
Write for your FREE copy of HERMETIC's informative new 32-page brochure, the most complete presentation ever offered on hermetic seals.

SEALED IN HERMETIC HEADERS

HERMETIC SEAL PRODUCTS CO. 31 So. Sixth St., Newark 7, N. J.

FIRST & FOREMOST IN MINIATURIZATION

Serving up TONS of Vacuum Melted Metals



Preparing samples of vacuum melted metals for analysis.

PRODUCTION on vacuum melted metals that was formerly measured in pounds can now be measured in tons. Vacuum Metals' new expanded facilities are capable of producing 5 tons per day of Gas Free High Purity metals and alloys.

Vacuum melting techniques provide metals of higher purity . . . and alloys held to closer composition tolerances than ever before achieved commercially.

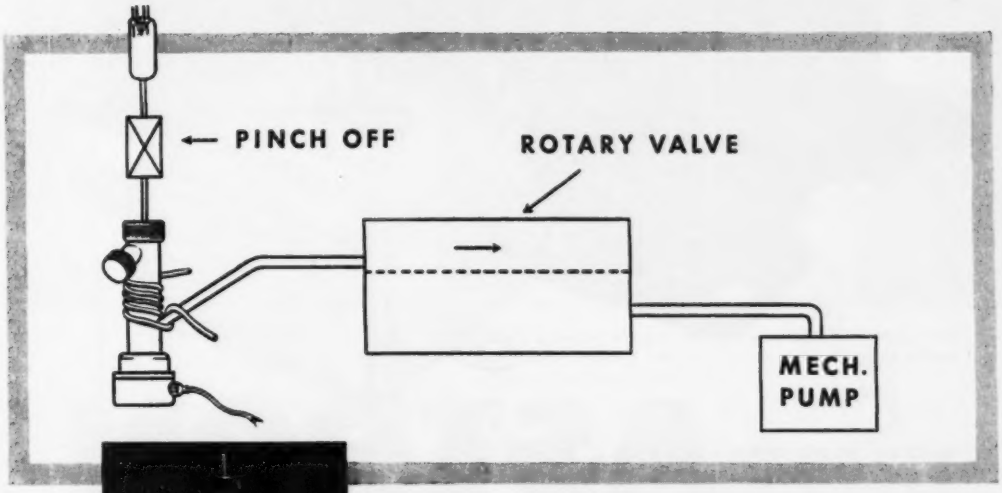
The unusual physical, chemical and electrical properties of these metals have proved of particular value for applications such as electronic and electrical parts, magnetic materials, bearing materials, diaphragms, instrument components, and Atomic Energy projects.

Metals now being vacuum melted include copper, nickel, iron, and molybdenum. Further information will be furnished gladly on request.

HIGH PURITY METALS
HIGH VACUUM CASTING
SPECIAL ALLOYS
GF (Gas Free) METALS

VACUUM METALS CORPORATION
Subsidiary of National Research Corporation
70 MEMORIAL DRIVE, CAMBRIDGE 42, MASSACHUSETTS

The Modern Way to Build Rotary Exhaust Equipment for Miniature Tubes

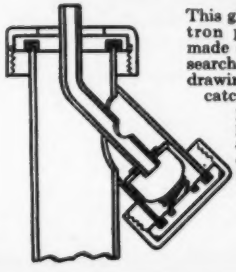


NRC's TYPE B-1 BOOSTER PUMP

- *Provides Higher Vacuum*
- *Reduces Exhaust Cycle*
- *Eliminates Troublesome Oil Vapors*

Our Type B-1 Booster Pump was built to meet ideal production methods as outlined by Hytron production engineers. On the production line it exactly meets their specifications in every detail — step by step. This Booster Pump lowers production costs. Its high speed reduces the exhaust cycle. Write for details.

HYTRON-DESIGNED GLASS TRAP
Ends Important Maintenance Problem



This glass trap, designed by Hytron production engineers, is made and sold by National Research. As you can see by the drawing at the left, the trap catches and holds broken glass particles. It works on the principle of a cyclone separator. The trap can be easily cleaned. Write for full details.

INDUSTRIAL RESEARCH
PROCESS DEVELOPMENT
HIGH VACUUM ENGINEERING
AND EQUIPMENT

METALLURGY
DENITRATION
DISTILLATION COATING
APPLIED PHYSICS

National Research Corporation

"Equipment Division"

Seventy Memorial Drive, Cambridge, Massachusetts

with ASTRON Subminiature

RF INTERFERENCE SUPPRESSION FILTERS

In filters, size and weight reduction need not mean *performance reduction.* Astron *Subminiature* RF Interference Suppression Filters provide for noise attenuation from 14 kc to 1000 mc with the desired characteristics of high impedance, low voltage drop, and minimum heating, in a package to fit your military or commercial needs. Through skillful use of metallized paper, new techniques, and specialized components—together with the engineering imagination that pioneered high temperature and high altitude filters—Astron is best equipped to solve your miniaturization problems.

Write us today, without obligation, outlining your filter requirements. Our engineers will forward recommendations promptly.

Astron also makes conventional filters, utilizing regular paper and foil capacitor designs. *Write for Catalog AC-3.*

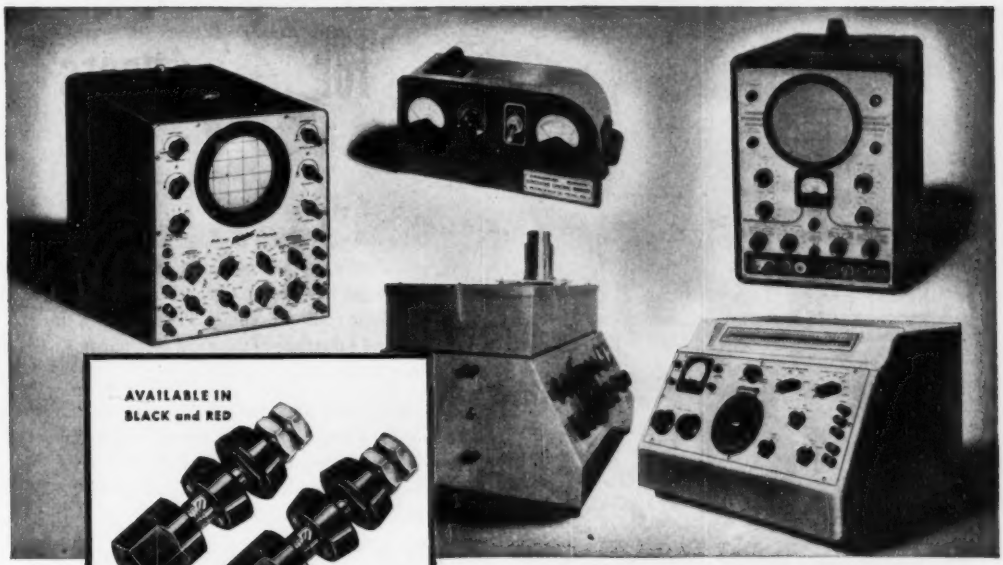
Depend On—Insist On

ASTRON

255 Grant Avenue, E. Newark, N. J.

Export Division: Rocke International Corp., 13 E. 40th St., N. Y. C. In Canada: Charles W. Pointon, 1926 Gerrard St. East, Toronto

FIRST CHOICE on EQUIPMENT of FINE QUALITY



More and more leading manufacturers are using 5-WAY Binding Posts to provide increased flexibility and improved performance of their electrical and electronic equipment.

SUPERIOR 5-WAY BINDING POSTS

1. Plug-in for standard 3/4" banana plug
2. Clip-lead to shaft
3. Wire looped around shaft and clamped
4. Wire (up to #12) permanently clamped through center hole
5. Clamped spade lug connection

Better electrically *and* mechanically, the rugged SUPERIOR 5-WAY Binding Post affords quick, safe and positive connections for practically every application. Mounting in any panel from 1/16" to 1/4" is easily accomplished by means of a single keyed or unkeyed hole. It provides complete insulation from the panel. Construction is extra strong. Only the most durable of phenolic plastics is used. The hexagonal shaped head can be tightened with a 1/2" socket wrench without damage. Current capacity is 30 amperes; working voltage is 1000 volts. The color choice of RED or BLACK permits ready circuit or polarity identification.

A FREE SAMPLE IS AVAILABLE IF REQUESTED ON YOUR LETTERHEAD. 210 THURE AVENUE, BRISTOL, CONNECTICUT

THE SUPERIOR ELECTRIC CO.
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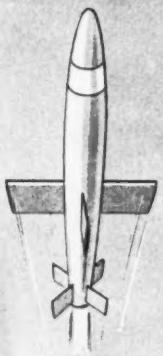
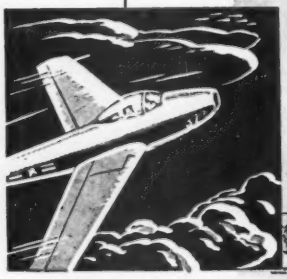
POWERSTAT Variable Transformers • STABILINE Automatic Voltage Transformers • VOLTBOX A-C Power Supplies • VARICELL D-C Power Supplies • POWERSTAT Light Dimming Equipment

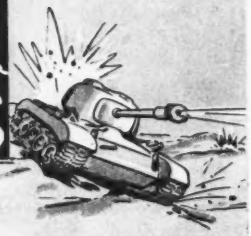
We've been solving automatic control problems for 37 years



Controlling guided missiles in flight

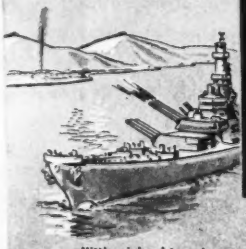


Knowing your whereabouts under all circumstances



Stabilizing the guns on bouncing tanks

Shooting down jet planes from the unstable decks of ships



Hitting inland targets from battleships

Take one part of the fantastic, mix thoroughly with Ford's engineering and production ability, and you've got the answer to another "impossible" automatic control problem. That has been the sum and substance of the Ford Instrument Company since 1915.

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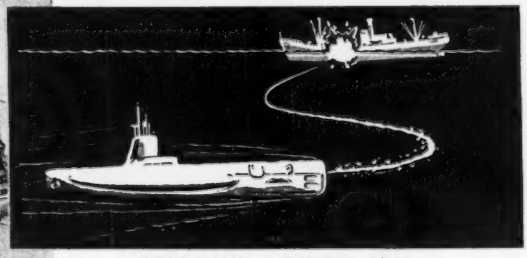

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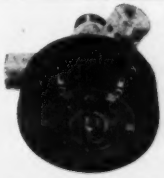
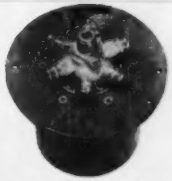
28 Volt D.C. Motor Actuated Coaxial Switch Model CA-71

Lobing Switch Model CA-31

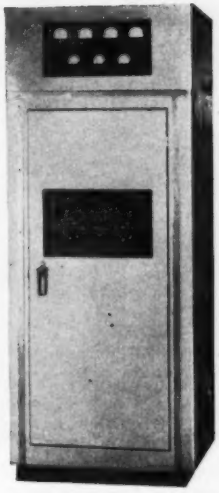


Manual Coaxial Switch Model CA-36

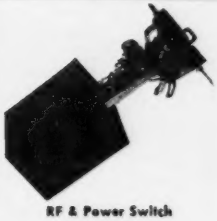


Motor Actuated Coaxial Switch Model CA-26

1P-2T Coaxial Switch Model CA-20

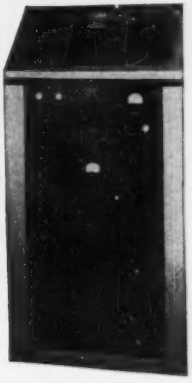


High Voltage Power Supply Unit Model BF-01

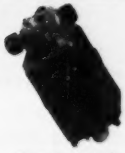


RF & Power Switch Model CA-60

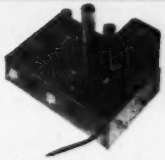
Antenna Switch Model CA-37



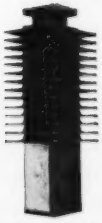
Polar Recorder Model BU-02



Transfer Switch Model CA-19



Logarithmic Amplifier Model BA-01



Dummy Load Model BL-07

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SANTA CLAUS

Could Die of Old Age

No one shoots Santa Claus. This remark about a government which spends and spends and spends may well be true. But it is also true that Santa Claus is an old man. At his age overwork might well kill him.

It is with the possibility of working Santa Claus to death that this editorial is concerned. No position is taken as between the contending political parties in the present campaign. Our concern is with the problem of protecting Santa Claus.

It is true that as a nation we now enjoy great prosperity. The prosperity is not nearly so general as the political advertisements of it would suggest. Millions of individuals, notably those living on pensions, annuities and other fixed incomes, have been robbed of half their purchasing power by inflation during recent years, and whole industries know little or nothing of boom times.

However, measured by so basic a gauge as unemployment, we do have great prosperity. Less than two million of our total working force of over 64 million are unemployed, and many of them are unemployed only while moving from one job to another. The real income, i.e., what their dollars will buy, of those with jobs is somewhere near its all-time peak.

Our Prosperity is Precarious

The prosperity we enjoy, however, is precarious. This is primarily because it is dependent upon a rising volume of expenditures by the federal government. At present almost a quarter of our entire national income is ladled out through Washington, and in an ever increasing amount.

If, as matters now stand, federal expenditures were to be suddenly and sharply cut, our government-financed prosperity would be severely upset. But if the federal government were to try to keep right on providing prosperity by steadily increasing its expenditures, the end result would be more certainly disastrous. It would be a crash caused primarily by having continuing inflation of prices destroy the value of the dollar.

Higher government expenditures of worthless dollars then could accomplish nothing. Santa Claus would be dead from overwork.

To Provide Firm Foundations

The general route to be followed in putting firm foundations under our prosperity is quite clear. It involves two steps which must be taken closely together. The first is to stop the continuous increase in federal expenditures. The second step is to substitute expanding private business for government-financed business as the principal foundation of expanding prosperity.

The increase in federal expenditures can be stopped without sacrificing any effective measures now directed toward meeting our top priority requirement—protection from armed Communist aggression. The most competent authorities of both major parties agree it can be done by (1) better planning of and the elimination of outright waste in defense arrangements, and (2) cutting those civilian expenditures which cannot be justified at the same time we are undertaking a great new load of defense expenditure.

It is also possible to substitute expanding private business for government-financed business. The problem is primarily that of relieving private business of the staggering load of federal taxation it now is carrying. Federal taxation now takes 52 per cent of all corporate profits and 82 per cent of all so-called excess profits. If it were not for the forced draft placed under our economy by rapidly mounting defense expenditures, this burden would surely lay a disastrous blight on private business expansion. If expanding private business is to have a chance to play its critical role as a subtitute for government-financed business, its taxes must be cut, and soon.

It Won't be Easy

It would be naive to contend that it will be easy to check the expansion of federal expenditures. They have been running wild too long, and in the process contributing to a feverish, inflationary prosperity. Likewise, there is no reason to believe that the easing of the load of business taxes is going to be easy. The basic blight it puts on business expansion has been too long obscured by having our economy dosed with artificial stimulants, most notably enormous injections of federal expenditures.

The Key Question—How Long?

It is obvious that prosperity is going to be a major topic of discussion in the present political campaign. There is nothing the matter with that. Prosperity is a key concern of the voters in choosing a national administration.

To make the discussion of prosperity really useful, however, it is important to ask and get answers to the right questions about it. The key question is not whether or not we have prosperity. That we have it in large measure is generally conceded.

The key question is, "How long can we continue to have prosperity?" The answer—not very long if we continue to rely primarily on new injections of inflationary federal expenditures. Santa Claus, be it remembered, is no youngster. If we continue our present improvident course, he will be worked to death. Those politicians, regardless of party, who see this clear danger and who have plans to escape it are facing up to the crucial question about our prosperity.

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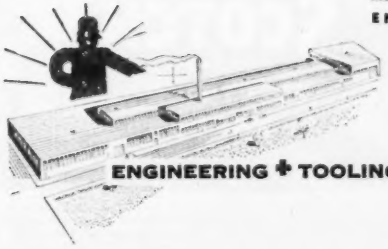

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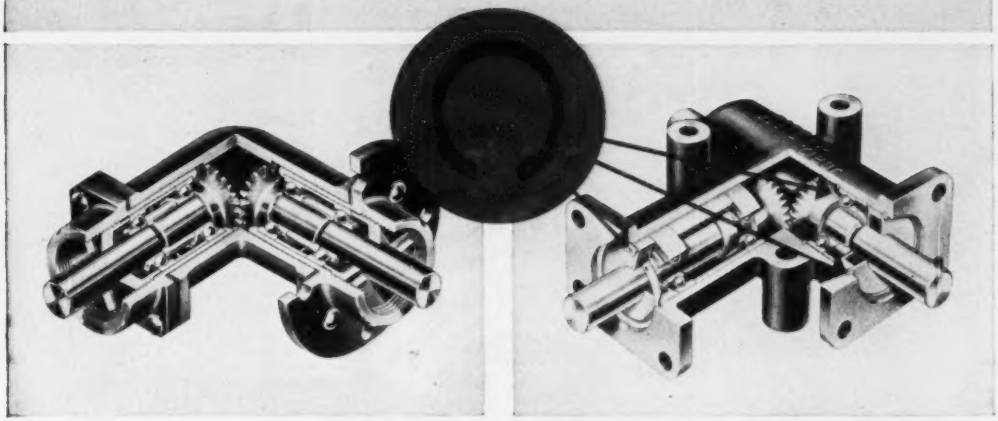

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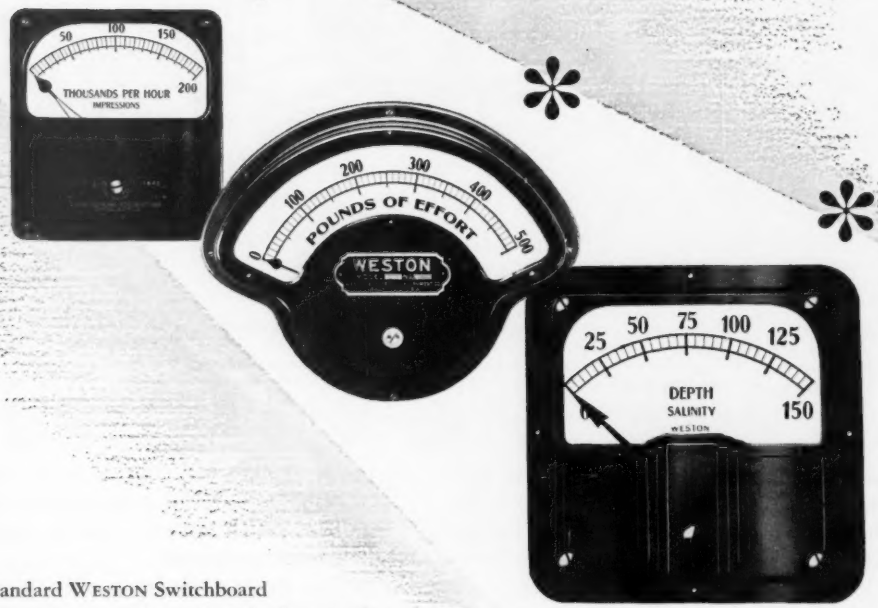

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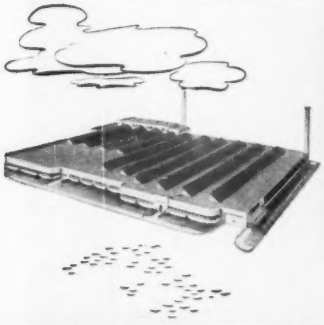
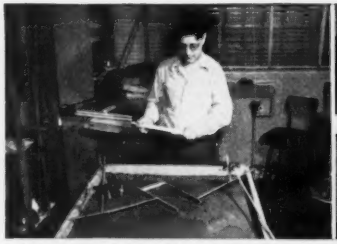
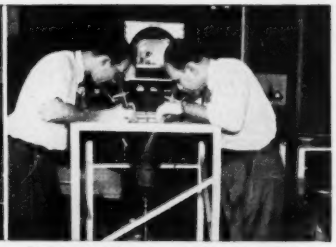


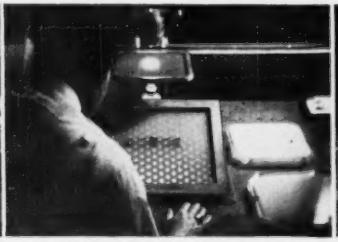


Rubber model for studying electron optical designing—basis for Rauland's exclusive Indicator Ion Trap.

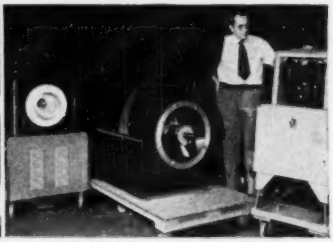


Alignment of the screen and parallax mask of tri-color tube containing approximately a million fluorescent dots.

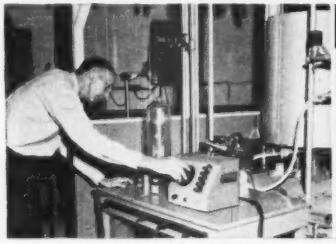
All-electronic tri-color tube in electronic receiver system (left) in comparison with mechanical system (right).



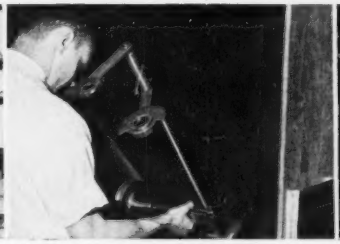
Inspection and checking of perforations .0075" in diameter in masks of tri-color picture tubes.



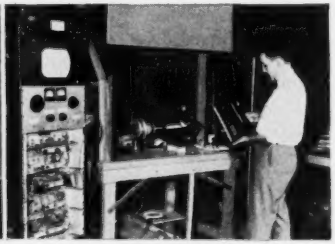
Rauland large-screen projectors using three different optical systems, all of which give theater-size pictures.



Careful study of the formation of thin metallic films in a vacuum . . . basis for the aluminizing of tubes.



Examination with polarimeter permits careful control of strains for superior glass-to-metal sealing.



A physicist using a Rauland-developed radiation meter in checking X-ray radiations from cathode ray apparatus.

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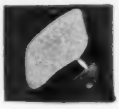

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TYPE ST-9A (500 VOLT)
Electrical Specifications

Power Requirements	105-125 volts (210-250 volts), 50/60 cycle, 320 watts maximum
Output Voltages	
#1 Regulated	Continuously variable, 0-500 volts, maximum current 100 ma
#2 Regulated	Same as #1
Parallel #1 and #2	Continuously variable, 0-500 volts, maximum current 150 ma
Unregulated	Approximately 650 volts no load, maximum current 200 ma
−75 Volts	VR tube regulation, 0-2 ma
−150 Volts	VR tube regulation, 0-4 ma
Filament Supply	6.3 volts a-c at 10 amps
Regulation	Better than ½% + ½ volt within the cross-hatched area of the graph (below)
Ripple and Noise	Less than 3.5 mv (10 mv peak-to-peak) on all regulated outputs
Instruments	Milliameter 0-300 ma d-c; voltmeter 0-500 volts d-c; voltage and current can be metered at #1 and #2 Regulated and Unregulated outputs; total current drawn from all outputs can be metered and it should not exceed 200 ma
Overload Protection	3 amp fuse in the a-c line; ⅜ amp fuse in the d-c line; overload of any degree on the regulated outputs will harm neither the supply itself nor the instruments.
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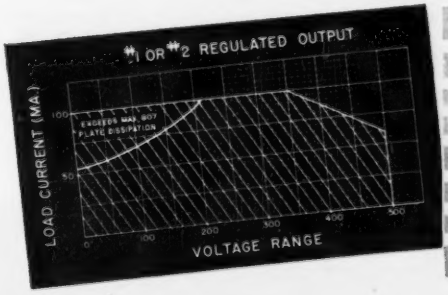
- Regulation specification holds over the full range of 0-500 volts.



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New wider frequency range
Time-tested RC circuits
No zero set. High stability
Constant output, low distortion

New convenience for laboratory, field or production measurements in sub-audio, audio, telephony, carrier current, super-sonic, telemetering and rf applications.

COMPACT, EASY TO USE BASIC INSTRUMENTS FOR LABORATORY OR PRODUCTION TESTS

Hewlett-Packard RC oscillators have long been basic tools for making electrical and electronic measurements of precise accuracy. Now these world-famous test instruments are redesigned to give you the most compact, dependable, accurate and easy-to-use commercial oscillators available.

New *-hp-* 200 series oscillators have highest stability and precisely accurate, easily resettable tuning circuits. Low impedance operating levels together with superior insulation guarantee peak performance throughout years of trouble-free service. New models have wider frequency range. Operation is simplified—just three front panel controls. Size is different, too—the instruments are more compact, lighter in weight and enclosed in an easy-to-handle aluminum case with carrying strap. Minimum bench space is required. (Rack mounting available on request.)

Complete Coverage! HEWLETT-PACKARD

OSCILLATORS

The total coverage of just two of the new *-hp-* oscillators is materially greater than that offered by four previous *-hp-* instruments. For example, new Model 200AB, for general audio tests, offers a wider frequency range of 20 cps to 40 kc and a full watt output. New *-hp-* 200CD, for wide-range measurements at lower power, provides constant voltage output from 5 cps to 600 kc.

In addition to these new instruments, *-hp-* continues to offer Model 200H for carrier current work up to 600 kc, and Model 202D for low frequency and vibration studies down to 2 cps. These instruments retain their time-tested design.

Components, insulation and other electrical and mechanical features are of the highest possible quality. The instruments are carefully adjusted and calibrated to meet exact frequency and performance specifications. An output amplifier provides complete isolation of the load, and changes in the output load cannot change the performance of the oscillator. Frequency stability is better than ±2% including warmup, and hum voltage is less than 0.1% of rated output.

-hp- 202A
Low Frequency
Function Generator

This instrument is a compact, convenient and versatile source of transient-free test voltages between 1,000 and 0.01 cps. It provides virtually distortion-free signals for vibration studies, servo application, medical and geophysical work and other subsonic and audio problems. The equipment generates 3 wave forms — sine, square and triangular. Output is 30 volts peak-to-peak for all wave forms. The output system is fully floating with respect to ground and may be used balanced or single-ended. The instrument will deliver 10 volts RMS to a 2,500 ohm load; internal impedance, however, is only 40 ohms. There are no coupling capacitors in the output system, and a high degree of dc balance is achieved by a special circuit. Price, $450.

BRIEF SPECIFICATIONS—200 SERIES OSCILLATORS

-hp- MODEL	FREQUENCY RANGE	BANDS	FREQUENCY RESPONSE	POWER OUTPUT	LOAD IMPEDANCE	DISTORTION	POWER CONSUMPTION	PRINCIPAL APPLICATIONS	PRICE
200AB	20 cps to 40 kc	4 ranges	± 1 db Ref. 1 kc	1 watt or 24.5 v	600 ohms	1%	60 watts	Audio Tests	$120.00
200CD	5 cps to 600 kc	5 ranges	± 1 db Ref. 1 kc	160 mw — 600 ohms or 20 volts open circuit*		1%	75 watts	Audio, Ultrasonic, tests	$150.00
200H	60 cps to 600 kc	4 decades	± 1 db Ref. 1 kc	10 mw or 1 v	100 ohms	1%, 100-100,000 cps 3%, 60-600,000 cps	115 watts	Carrier Current & Telephone Tests	$350.00
202D	2 cps to 70 kc	5 ranges	± 1 db Ref. 1 kc	100 mw or 10 v	1,000 ohms	1%	80 watts	Low Frequency Measurement	$275.00
200I	6 cps to 6 kc	6 ranges	± 1 db Ref. 400 cps	100 mw or 10 v	1,000 ohms	1% 10-6,000 cps	115 watts	Interpolation and Frequency Measurement	$225.00

(*Internal impedance 600 ohms.)

Data subject to change without notice.

Prices f.o.b. factory.

HEWLETT-PACKARD COMPANY
Field Engineers in Principal Cities
2523A PAGE MILL ROAD • PALO ALTO, CALIFORNIA

hp INSTRUMENTS – Complete Coverage!

edwin i. guthman & co., inc.

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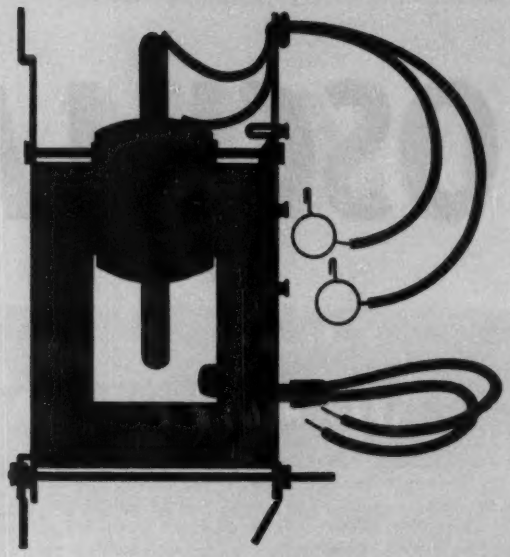
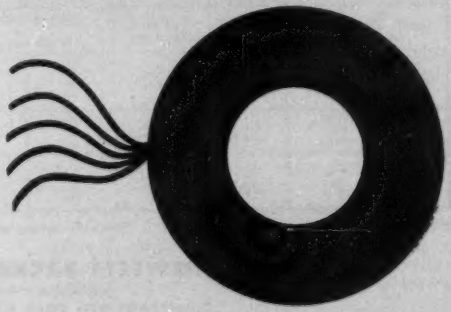


flyback transformers

For reliability in high voltage specify Guthman Flybacks—they wont break down even under the most severe voltage requirements. Wire used in Guthman Flybacks is fabricated in our own plant and is quality controlled from raw material to finished product guaranteeing a superior uniformity of performance. The excellent linearity and voltage regulation characteristics of Guthman Flybacks aids in preserving picture quality.

Coils used in Guthman Yokes are form wound. Complete isolation between vertical and horizontal coils achieved by a molded nylon piece permits a yoke rating of 5,000 volts pulse maximum. Anti-magnetic core retainer band and brass mounting nut assures no magnetism in Guthman Yokes.



DELAY LINES
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ANTENNA COILS
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I.F. TRANSFORMERS
LOOP ANTENNAS
R.F. TUNERS

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BURTON BROWNE ADVERTISING

4

THIS IS NOT a TAFT-HARTLEY CIRCUIT BREAKER

Unique in the field of circuit protection equipment, **HEINEMANN** Circuit Breakers do not require a "cooling-off period." Immediately after correction of a fault, either short circuit or overload, **HEINEMANN** Circuit Breakers can be turned ON. There is no waiting for a thermal element to cool . . . no wasted production time . . . no reset procedure . . . just restore service by throwing the switch to the ON position.

NO WAITING TO RESET . . . YET NEVER NUISANCE TRIPPING

While there is no waiting to reset after tripping, **HEINEMANN** Circuit Breakers do provide time delay before tripping to allow for **temporary, harmless** overloads, thus avoid nuisance tripping. This allows for the initial inrush of starting motors and other equipment.

TIME DELAY FOR OVERLOADS . . . YET INSTANTANEOUS SHORT CIRCUIT PROTECTION

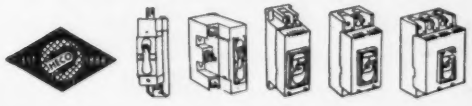
Beyond providing time delay for overloads, the hydraulic-magnetic operating principle of **HEINEMANN** Circuit Breakers differentiates between overloads and short circuits. **HEINEMANN** Circuit Breakers always trip instantly at ten times the rated current . . . providing the fast protection you must have for your wiring and equipment even at the low short circuit values.

KNOW THE FACTS . . .

Send for this new informative booklet entitled, "WHAT YOU SHOULD KNOW ABOUT CIRCUIT BREAKERS." Ask for Manual 101 . . . no obligation, of course.

HEINEMANN ELECTRIC COMPANY

97 Plum Street • Trenton 2, N. J.



Heinemann Circuit Breakers. One, two and three pole. 10 milliamps to 100 amperes.

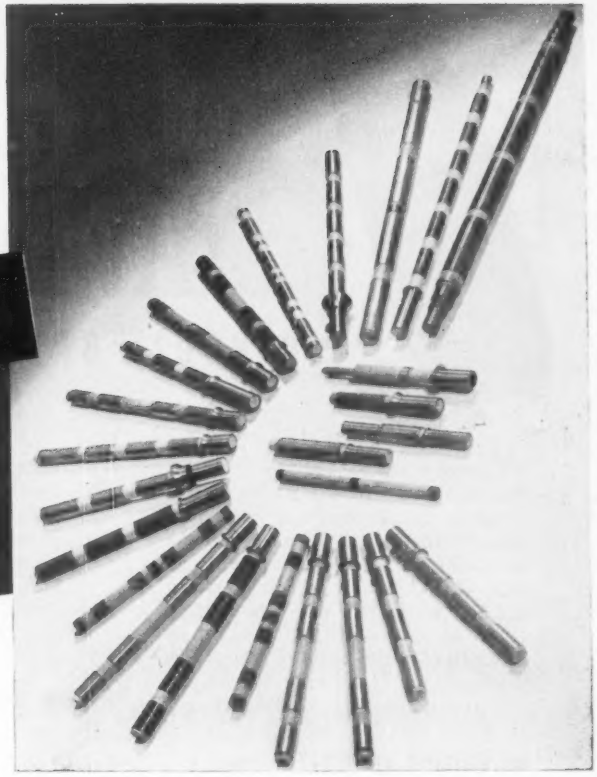
HEINEMANN *Circuit breakers*

Simplify your production procedure with High-precision

Stupakoff

CERAMIC to Metal ASSEMBLIES

for Electrical and Electronic Applications

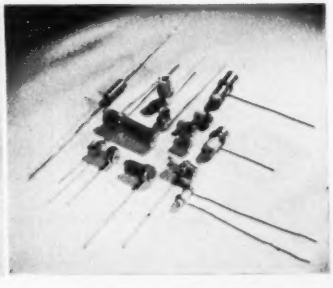


To combine ceramic and metal parts into one permanent unit, Stupakoff draws upon extensive experience with both materials. Methods of assembly employed by Stupakoff include: metallizing, soldering, pressing, spinning and others. Among the metals assembled to ceramics are silver, copper, brass, stainless steel and monel.

The rotor shafts shown above consist of metal bands attached securely to ceramic rods, and exemplify Stupakoff precision manufacture. On a mass production basis, concentricity of components, for example, are held to less than ± 0.001 in. Likewise, the strains and spreaders, stand-offs and trimmers shown below meet the exacting requirements of the service for which they are made.

Stupakoff high-precision ceramic assemblies offer many opportunities to reduce costs, increase production and improve electrical and electronic equipment.

We will be glad to discuss your requirements with you and to submit samples for your inspection.



STUPAKOFF
CERAMIC & MANUFACTURING CO.

LATROBE, PENNSYLVANIA

Ready for Your Circuit

Basic Foundation Components, Plug In, Connecting, Fastening Devices for the

ELECTRONIC CONTROL INDUSTRY

Making it possible to build quickly any electronic circuit into practical production design (you supply the circuit — we supply the components).

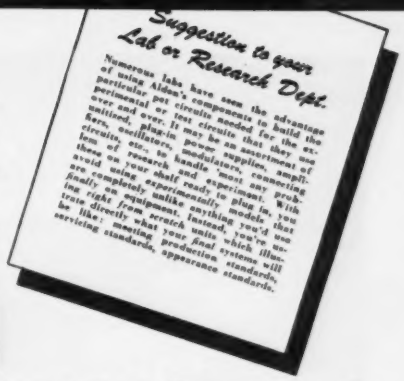
— by giving you basic components of tremendous flexibility which simplify layout time in production of your equipment.

— by providing you a technique to solve mechanical, space, connecting, interconnecting, fastening, sensing and indicating problems for you.

Giving you equipment that is easy to operate and maintain

— so that — with spares — your equipment never needs to be out of operation more than 30 seconds.

— so that non-technical personnel can set up, operate and maintain your equipment.



WORKING WITH "ALDEN'S HANDBOOK", THE DESIGN ENGINEER AUTOMATICALLY CREATES *PRACTICAL PRODUCTION DESIGN*, as follows —

1. **Anything electrical or electronic usually operates with an *outside source* of power and may be connected to outside circuits.** So Alden provides for this with the efficient Detachable Line Cord for bringing in 110V AC power. Available in lengths to your specs for making a neat connection. Sure grip plug is self-piloting for quick mating.

   SEE "ALDEN HANDBOOK" PAGES 4A & B FOR COMPLETE DETAILS

2. **A great deal of equipment will have a front panel with such things as sensing controls, jacks for testing and fuseholders.** For this Alden provides a basic slide-in chassis with a detachable front and back panel so that rheostats, indicator lights, test jacks, interwiring, etc. are all easy-to-work subassembly operations.

   SEE "ALDEN HANDBOOK" PAGES PI-1E thru G FOR COMPLETE DETAILS

3. **Sensing Units — telltales that all is well or not — in simple indicator light — fuse holders that glow when blown — memory or pulse circuits including Static Magnetic Memory that sense — or command — or keep on repeating so that units or elements almost assume brain functions.**

   SEE "ALDEN HANDBOOK" PAGES ES-5A & B; DL-5A & B; TE-3A & B; CG — all pages

4. **The telephone, telegraph, electric light companies have always brought the incoming circuits to a bus bar or terminal board so that the *incoming circuits* could *always be checked at one point* — and equipment connected not being condemned because of imperfect outside circuits.** So Alden provides in its Back Connectors and supporting Back Plates the one area in which all incoming circuits can be checked.

   SEE "ALDEN HANDBOOK" PAGES PI-2A & B; 4D FOR COMPLETE DETAILS

5. **The next problem is to house the components and have them do the electrical or electronic work required.** Any such circuitry will have certain main functions and branching from it other functions. Many of these functions can be layered—so circuits go direct from back connector to front panel. Alden provides: simple component mounting panels for putting any circuit in layers. (And incidentally such component panel simplify the thinking, should the circuits give sufficient volume to be printed.) So Alden has the Terminal Panel Boards to make equipment easy to lay out by putting any function in one plane—plus the unit cables of correct lengths with stripped ends ready for interconnecting the Terminal Panels.

   SEE "ALDEN HANDBOOK" PAGES PI-1B thru D FOR COMPLETE DETAILS

6. **Not all circuits can be a simple, straight circuit from back connector to front panel because there are auxiliary functions and branches that have to be in the main functions.** The usual chassis carries tubes, transformers and components that rise vertically from the chassis, often leaving vacant spaces. In these spaces can be placed the plug-in units which have these secondary circuits; using the plug-in technique usually removes the congestion of the wiring below the chassis, provides automatically for shielding and heat dispersion and yet gives you largest amount possible circuitry per cubic space, the circuits free from interaction.

   SEE "ALDEN HANDBOOK" PAGES PI-1A thru H FOR COMPLETE DETAILS

7. **Again these techniques often lead to putting one function such as a power supply and amplifier on separate chassis and so the back connectors or the chassis itself may need interconnecting unit cables to either chassis or racks.** Alden provides sufficient variety of connectors to choose from—and designed so that any cable, no matter how involved, cannot be wrongly plugged in.

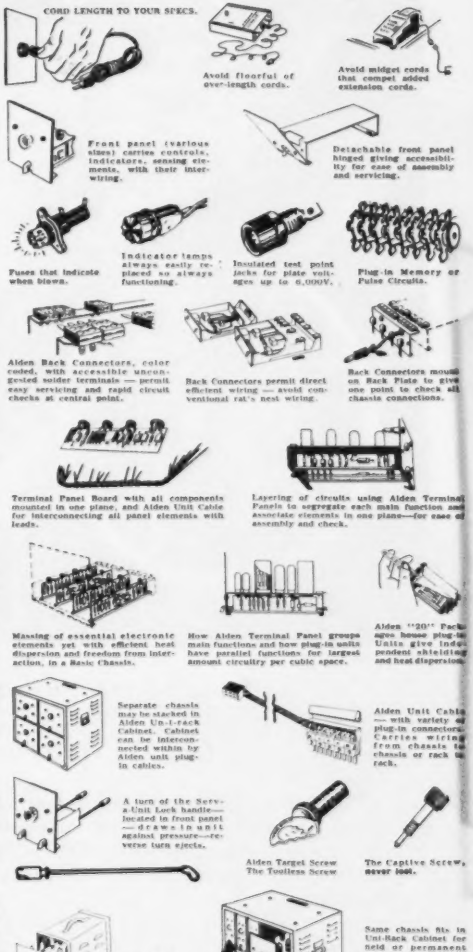
   SEE "ALDEN HANDBOOK" Sec. PC - Sec. MPS FOR COMPLETE DETAILS

8. **To design so that no equipment — whether plug-in unit or slide-in chassis — needs to be out of operation for more than 30 seconds (having adequate spares on hand), Alden provides quick detaching and quick fastening devices for chassis.** The Serve-a-Unit locks that will move chassis against weight or the resistance of gaskets. There is the Target Screw (coin operated), a Tool-less screw—the Captive Screw which becomes part of the equipment.

   SEE "ALDEN HANDBOOK" PAGE PI-11 FOR COMPLETE DETAILS

9. **Government designers and those in the electronic control industry want elements of equipment so that they can be portably operated or tested, can be carried by one man with spares, parts easily sent by mail or airborne and also prefer that the same design equipment can be used in conventional racks.** Those designing for field operation use, at sea, prefer to have the equipment so it can be unloaded by two people, set up and immediately interconnected. This is provided by the Alden Basic Chassis using Back Connectors, Unit Cables and for the last purpose, the Uni-Rack which can be set on top of one another and immediately interconnected with each other.

   SEE "ALDEN HANDBOOK" PAGE PI-11 FOR COMPLETE DETAILS

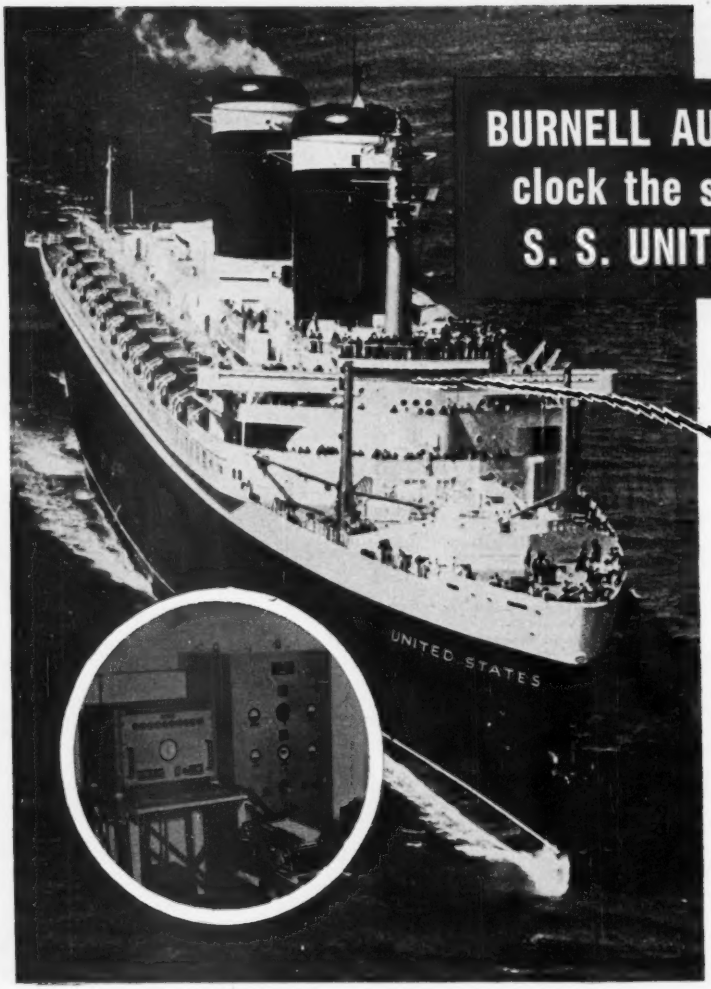

CORD LENGTH TO YOUR SPECS.
Avoid floorful of over-length cords.
Avoid midget cords that compel added extension cords.
Front panel (various sizes) carries controls, indicators, sensing elements, with their interwiring.
Detachable front panel hinged giving accessibility for ease of assembly and servicing.
Fuses that indicate when blown.
Indicator lamps always easily replaced so always functioning.
Insulated test point jacks for plate voltages up to 6,000V.
Plug-in Memory or Pulse Circuits.
Alden Back Connectors, color coded, with accessible unsoldered solder terminals — permit easy servicing and rapid circuit checks at central point.
Back Connectors permit direct efficient wiring — avoid conventional rat's nest wiring.
Back Connectors mount on Back Plate to give one point to check all chassis connections.
Terminal Panel Board with all components mounted in one plane, and Alden Unit Cable for interconnecting all panel elements with leads.
Layering of circuits using Alden Terminal Panels to segregate each main function and associate elements in one plane—for ease of assembly and check.
Massing of essential electronic elements yet with efficient heat dispersion and freedom from interaction, in a Basic Chassis.
How Alden Terminal Panel groups main functions and how plug-in units have parallel functions for largest amount circuitry per cubic space.
Alden "20" Packages house plug-in Units give independent shielding and heat dispersion.
Separate chassis may be stacked in Alden Un-i-rack Cabinet. Cabinet can be interconnected within by Alden unit plug-in cables.
Alden Unit Cables — with variety of plug-in connectors. Carries wiring from chassis to chassis or rack to rack.
A turn of the Serve-a-Unit Lock handle — located in front panel — draws in unit against pressure — reverse turn ejects.
Alden Target Screw The Toolless Screw
The Captive Screw, never lost.
Chassis in carrying or serviceman's case or case to house spare.
Same chassis fits in Uni-Rack Cabinet for field or permanent use. In field all elements can be connected as fast as you can unload them.

SEND FOR the Alden Handbook—your key to *practical production design*—with components already tooled—yet can be modified—ready for volume production without delays or procurement headaches.

NA-ALD

ALDEN PRODUCTS COMPANY 127 North Main Street, Brockton, Massachusetts

BURNELL AUDIO FILTERS clock the speed of the S. S. UNITED STATES



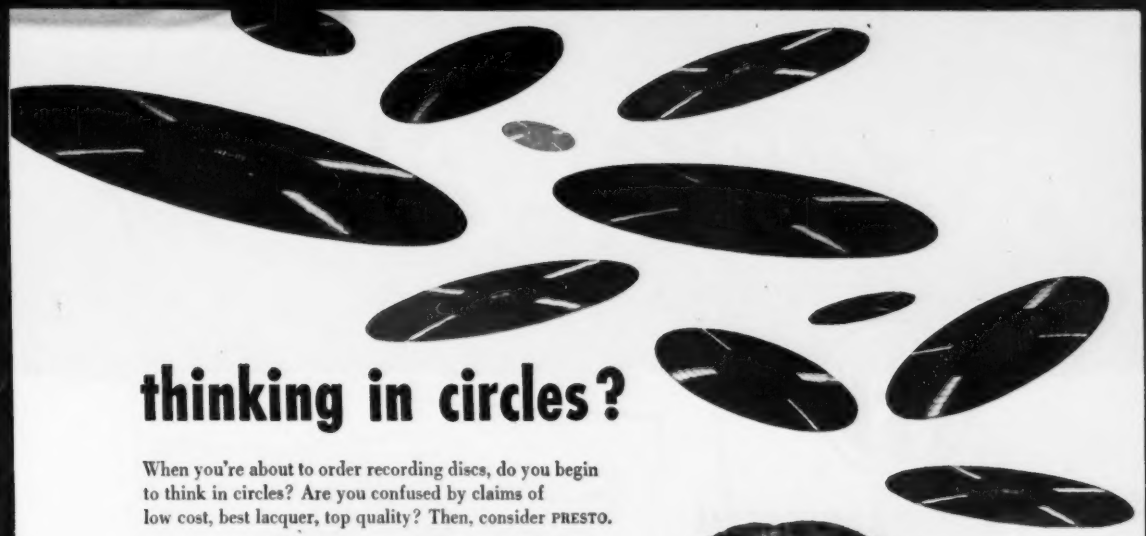
WE ARE PROUD TO ANNOUNCE THAT *ONLY* BURNELL & COMPANY AUDIO FILTERS WERE EMPLOYED IN THE HASTINGS INSTRUMENT COMPANY RAYDIST EQUIPMENT ABOARD THE S. S. UNITED STATES ON ITS RECORD SHATTERING RUN.

"Although the forces of nature combined to make the speed run AND the speed measurement extremely difficult, our raydist equipment using BURNELL filters surmounted all handicaps and exceeded specified accuracy", said Mr. Hastings.

WE ARE HAPPY TO ADD THIS TO OUR EVER INCREASING LIST OF TESTIMONIALS ON THE QUALITY OF BURNELL'S TOROIDS AND AUDIO FILTERS.

Exclusive Manufacturers of Communications Network Components

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

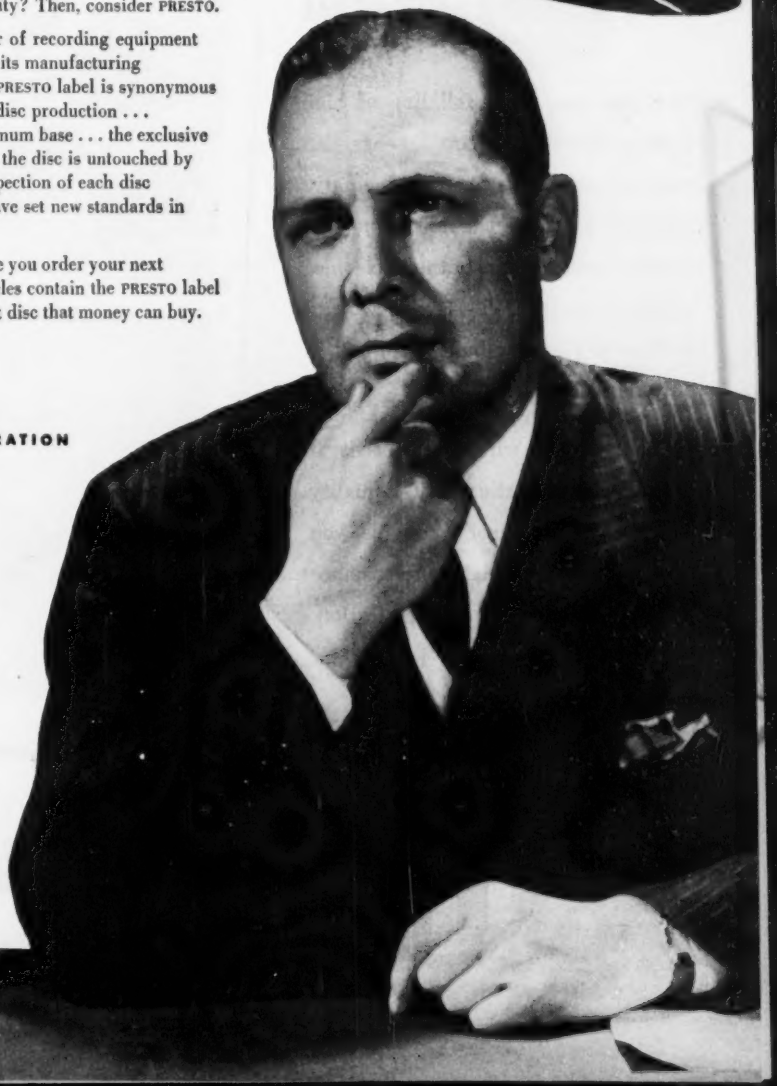


thinking in circles?

When you're about to order recording discs, do you begin to think in circles? Are you confused by claims of low cost, best lacquer, top quality? Then, consider PRESTO.

As America's pioneer producer of recording equipment and discs, PRESTO has brought its manufacturing process to the point where the PRESTO label is synonymous with perfection. Every step of disc production . . . the selection of the finest aluminum base . . . the exclusive lacquer flowing process, where the disc is untouched by human hands . . . the rigid inspection of each disc and the long curing process have set new standards in the disc industry.

It pays to think in circles before you order your next recording disc . . . if those circles contain the PRESTO label . . . your assurance of the finest disc that money can buy.



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WORLD'S LARGEST MANUFACTURER
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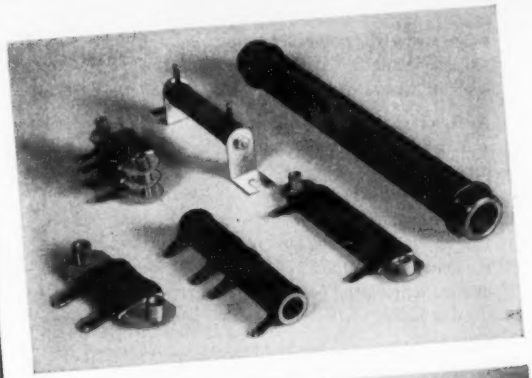
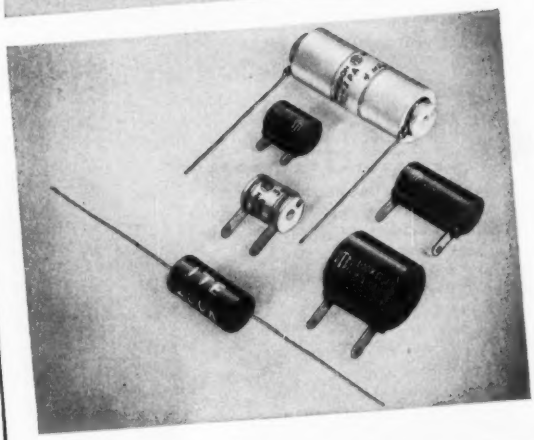
PRECISION-BUILT for

WIRE-WOUND COMPONENTS

Now you can get a full line of high quality wire-wound components—all from one reliable source. Specially designed to meet the exacting and changing requirements of the electronics industry, every I-T-E wire-wound product is precision-built by quality-controlled methods.

Whatever your wire-wound needs, it will pay you to investigate I-T-E quality products. They're made to give you long, accurate, dependable performance —in every critical electronic application.





specify **WIRE-WOUND**

I-T-E RESISTOR

1924 HAMILTON STREET • PHILADELPHIA 30, PA.

dependable performance

I-T-E POWER RESISTORS

- **Non-hygroscopic ceramic foundations** are in accordance with JAN specifications.
- **Purest resistance wires** are uniformly wound to prevent shorted turns and excessive hot spots. All connections silver-soldered.
- **Vitreous enamel coating** (organic if required) provides a glazed moisture-repellent surface with fast heat-dissipation qualities.
- **Advanced production methods** assure high stability, long life.

Standard fixed resistors:
5-200 watts

Adjustable resistors:
10-200 watts

Oval resistors:
30-75 watts

Ferrule resistors:
12-200 watts

Special resistors:
built to specifications

Standard tolerance: ±10%. ±5% and less made to order.

I-T-E PRECISION RESISTORS

- **High quality wire alloys** are used—free from internal stresses and strains.
- **Automatic precision winding** assures even tension—eliminates hot spots.
- **Hermetic or vacuum-impregnated** sealing protects against destructive effects of salts, moisture, and atmospheric conditions.
- **Accelerated aging process** prior to calibration assures accuracy.
- **Critical quality control** eliminates all resistors which do not come up to high I-T-E standards.

TYPE A:
lightweight, hermetically sealed—for precision operation up to 125 C. Surpass JAN R-93 A, *Characteristic A*, and MIL R-93 A specifications.

TYPE B:
Vacuum-impregnated, moisture-resistant. For JAN R-93, *Characteristic B*, specifications.

Ratings from 0.01 ohm—10 megohms, 0.125—5 watts.

Standard tolerance: ±1%. Available in specified tolerances down to ±0.05%.

I-T-E DEFLECTION YOKES

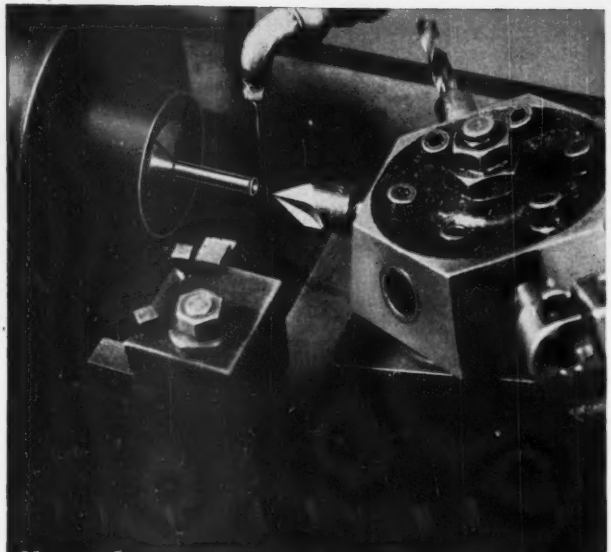
I-T-E offers you high quality deflection yokes—all built with uniform characteristics. Wire size and quality are constantly checked. Coils are impregnated in special moisture-resistant thermoplastic—properly cured to insure a firm coil with minimum losses. Deflection yokes can be obtained complete with wire leads, resistors, and capacitors—to your specifications.

FOR DETAILS—
get in touch with your nearest I-T-E representative. Or, send for your copies of the I-T-E *Power Resistor Catalog* and the new *Precision Resistor Bulletin 100A* today.

PRODUCTS

DIVISION

A DIVISION OF THE I-T-E CIRCUIT BREAKER CO.



How Superior Fabricates Tubing

to give you the parts you need

Need a tubular part machined, inside or out, at one or both ends?

Like to have it drilled transversely at one or several points?

Want it to meet rigid dimensional and metallurgical specifications?

You're reading the right advertisement for all of these are Superior Specialties.

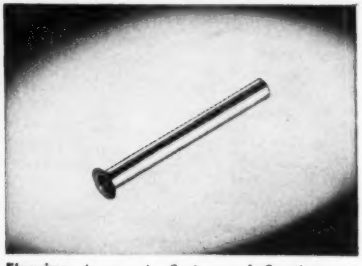
Superior has the experienced men, the specialized, highly developed equipment, the floor space, and the research facilities to produce quantities of drilled and machined tubular parts rapidly and economically.

It's a job we like to do and know how to do. But there's more to the story than simple production of fabricated or semi-finished parts, or even top-quality tubing in any analysis and many sizes.

The rest of the story is our willingness, desire and ability to work closely with customers' development engineers and product designers. Frequently we are able to materially assist in design of parts, selection of analysis, and development of processes. Many times we have been able to suggest minor changes in shape or method to effect major economies in assembly time and product cost.

If you are a manufacturer or an experimenter in electronics and have a need for a tubular part of any kind, check with us. We can probably help by giving you quantity production of the parts you need. Write Superior Tube Company, 2500 Germantown Ave., Norristown, Pennsylvania.

Cut and Annealed. Extensive cutting equipment, hand cutting jigs, electronically controlled annealers and other equipment, much of it developed within our own organization results in high speed, precision production of parts.



Flanging. Automatic flaring and flanging machines are combined in Superior's Electronics Division with carefully trained production and inspection personnel who know how to do a job right and take the time to be sure.

Expanded. Here is a part almost ready for delivery. Simple as it looks, it may well have been the subject of a score of operations and at every stage the prime consideration has been the *quality* of the finished part.

This Belongs in Your Reference File

. . . Send for It Today.

NICKEL ALLOYS FOR OXIDE-COATED CATHODES: This reprint describes the manufacturing of the cathode sleeve from the refining of the base metal. Includes the action of the small percentage impurities upon the vapor pressure, sublimation rate of the nickel base; also future trends of cathode materials are evaluated.

Superior

THE BIG NAME IN SMALL TUBING

All analyses .010" to ⅝" O.D.
Certain analyses (.035" max. wall) Up to 1⅜" O.D.

***SUPERIOR TUBE COMPANY** • Electronic products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800*

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It's a **FACT** . . .

. . . Kinney originated the rotating plunger vacuum pump . . . universally acclaimed for fast pump down and quick recovery.

It's a **FACT** . . .

. . . Kinney pioneered the oil-sealed pumping system.

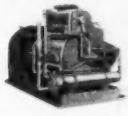
It's a **FACT** . . .

. . . Kinney is the BIG LINE of mechanical vacuum pumps . . . more models, more sizes, more capacities to choose from.

It's a **FACT** . . .

. . . Only Kinney offers in such a wide range both single stage and compound vacuum pumps — for creating and maintaining low absolute pressures alone or with diffusion pumps.

It's a **FACT** . . .



. . . More vacuum processes depend on Kinney Vacuum Pumps than on any other make or type of pump.

Find out for yourself how Kinney Vacuum Pumps can help in your low pressure processes — in laboratory, pilot plant, or production.

Send coupon or write for details.

Kinney

Kinney Manufacturing Co., Boston 30, Mass. Representatives in New York, Chicago, Detroit, Cleveland, Atlanta, Philadelphia, Pittsburgh, Johnstown (Pa.), Los Angeles, Charleston (W. Va.), Houston, New Orleans, San Francisco, Seattle and foreign countries.

KINNEY MANUFACTURING CO.
3565 Washington St., Boston 30, Mass.

Please send new Bulletin V-51B. Our vacuum problem involves:

- ☐ Vacuum drying
- ☐ Vacuum coating
- ☐ Vacuum metallurgy
- ☐ Vacuum impregnating
- ☐ Vacuum distillation
- ☐ Vacuum research

Name _____

Company _____

Address _____

City _____ State _____

SUBSIDIARY OF THE NEW YORK AIR BRAKE CO.

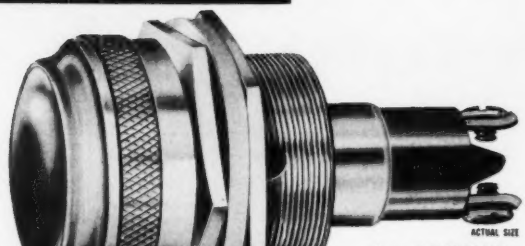
for **YOUR** *product*

WHICH PILOT LIGHT DO YOU NEED?

DIALCO

THE BIG ONE

This Pilot Light Assembly was first made to accommodate the *S-11 lamp* and was intended for use in the cabs of great diesel locomotives.



ACTUAL SIZE

Cat. #613529-211

This BIG one

or

this LITTLE one

Dialco HAS THE COMPLETE LINE OF INDICATOR and PANEL LIGHTS

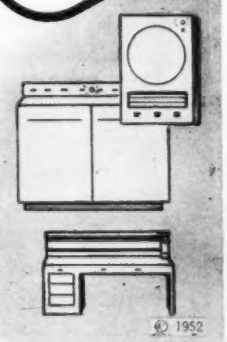
THE LITTLE ONE

The miniaturization program on defense products required the development of this *sub-miniature* light. It is used on communication equipment and aircraft. Midget flanged base bulbs to fit are rated 1.3, 6, 12, and 28 volts.

ACTUAL SIZE

Cat. #8-1930-621

Samples to suit your own special conditions and requirements will be sent promptly and *without cost*. Just outline your needs. Let our engineering department assist in selecting the *right lamp* and the *best pilot light* for YOU.



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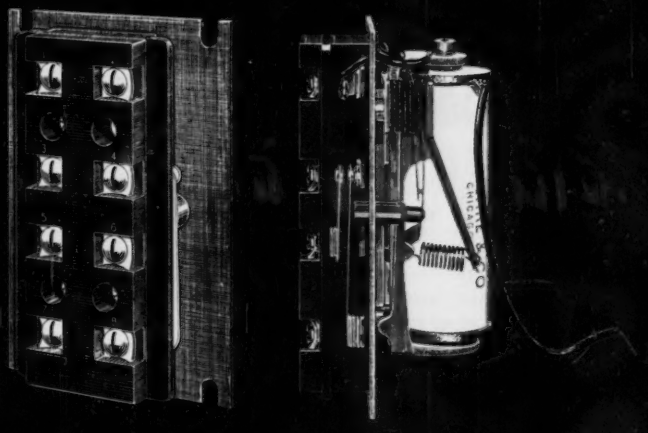
Write for the Dialco HANDBOOK of PILOT LIGHTS

Foremost Manufacturer of Pilot Lights

The DIAL LIGHT COMPANY of AMERICA

60 STEWART AVE., BROOKLYN 37, N. Y. HYACINTH 7-7600

Bring your relay problems to CLARE



Front View Side View

CLARE Type "CP" POWER RELAY

●Some of the most important relay developments of the past decade have been the result of CLARE cooperation with engineering staffs of acknowledged leaders in the electrical and electronic industries.

Development of the CLARE Type CP Power Relay, for instance, came about from a consultation with a large electrical manufacturer who uses power relays extensively in the manufacture of various electronic control units. This CLARE customer objected to the use of ordinary power relays in plate circuit applications because one watt or more was required to operate them. Also, this necessitated the use of a high-current thyratron tube, or the interposition of another, more sensitive relay. He wanted a power relay sensitive enough to operate in the plate circuit of any triode, including miniatures.

Years of satisfactory service from CLARE telephone-type relays had convinced the customer's engineers that the best way to achieve this would be to adapt these sensitive, dependable, durable relays to suit the special requirements of their use as power relays. Valuable contributions to the design of the CLARE Type CP Power Relay were made by the customer's engineers.

The result of this cooperation between these engineers and the CLARE engineering staff is a relay which simplified control equipment, saves money and space, and will outwear several ordinary power relays.

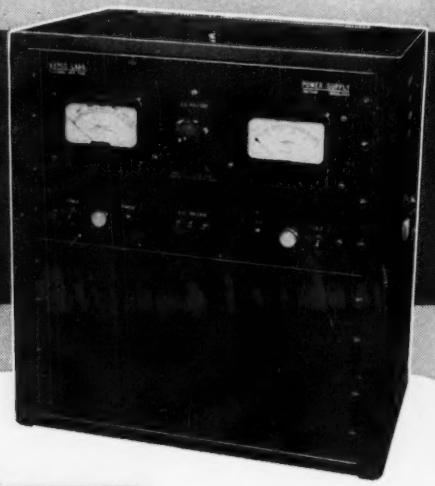
CLARE engineers, both in the field and in the plant, are anxious and willing to cooperate with you and your engineers to solve perplexing relay problems. Call the nearest CLARE office or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.

CLARE RELAYS

First in the Industrial Field

VOLTAGE REGULATED POWER SUPPLY

MODEL 700



The Kepco Model 700 features one regulated voltage supply with excellent regulation, low ripple content and low output impedance.

SPECIFICATIONS

OUTPUT VOLTAGE DC: 0-350 volts continuously variable.

OUTPUT CURRENT DC: 0-750 milliamperes continuous duty.

REGULATION: In the range 30-350 volts the output voltage variation is less than ½% for both line fluctuations from 105-125 volts and load variation from minimum to maximum current.

RIPPLE VOLTAGE: Less than 10 millivolts.

FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to protect rectifier tubes.

POWER REQUIREMENTS: 105-125 volts, 50-60 cycles.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post mounted on the front of the panel is available for connecting to the chassis. All terminals are also brought out at the back of the chassis.

METERS:
Ammeter: 0-1 ampere, 4" rectangular.
Voltmeter: 0-500 volts, 4" rectangular.

PHYSICAL SPECIFICATIONS: Cabinet height 22¾", width 21¾", depth 15¼". Rack panel height 21", width 19", color gray, panel engraved.

CONTROLS: Power on-off switch, H.V. on-off switch, H.V. control.

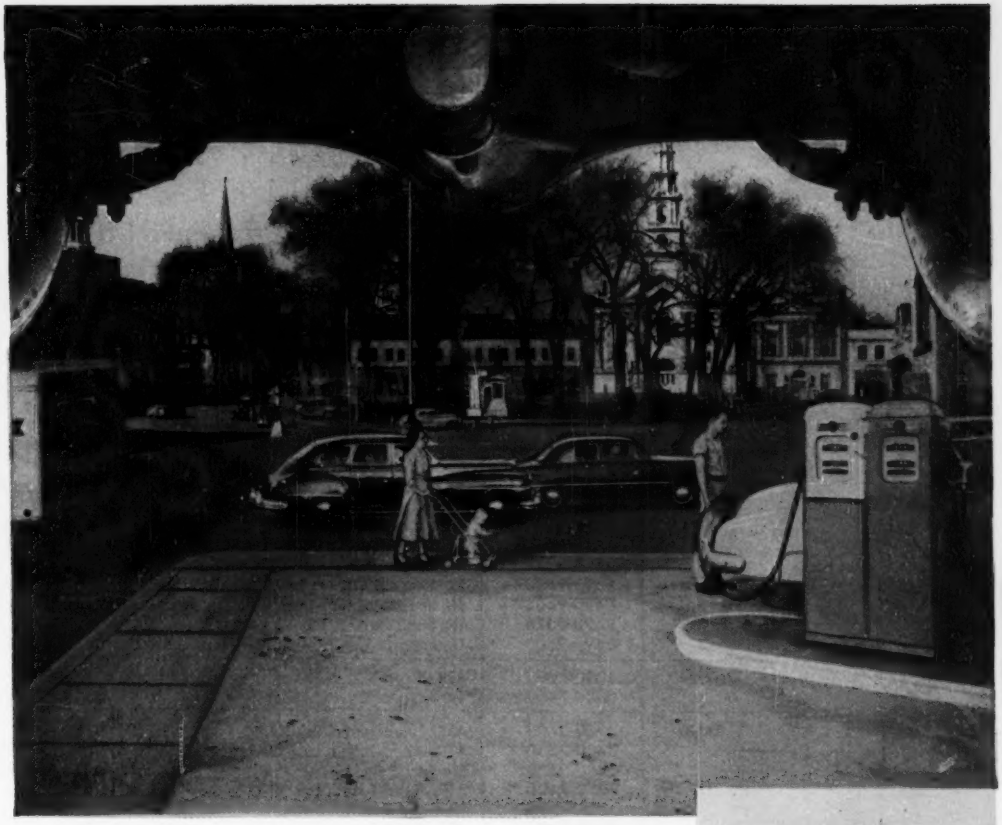
FOR NEW POWER SUPPLY CATALOG — WRITE DEPT. #1

ADDITIONAL MODELS AVAILABLE IN THE 700 SERIES VOLTAGE REGULATED POWER SUPPLIES

Volts	Current	Model
0-350	0-0.75 Amp.	700
0-350	0-1.50 Amp.	710
0-350	0-2.25 Amp.	720
0-350	0-3.00 Amp.	730
0-600	0-0.75 Amp.	750
0-600	0-1.50 Amp.	760
0-600	0-2.25 Amp.	770
0-600	0-3.00 Amp.	780

KEPCO LABORATORIES, Inc.

131-38 SANFORD AVENUE FLUSHING 55, NEW YORK



If it uses gas, it can use SYNTHANE

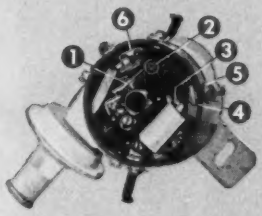
"I like to stand at the corner of Market and Main in my home town," one Synthane representative tells us, "and watch the traffic on a Saturday afternoon."

"There are our customers on parade . . . anything that uses gas—passenger cars, trucks, fire engines, motorcycles . . . Joe Zink's tractor . . . even the gas pumps at Eddie's service station use parts made from Synthane laminated plastics."

The reason is plain. When America turns on the ignition key it expects to go places. Back of this confidence are components.

Reliable components have to be made from dependable materials. Synthane is such a material. So you find it in water pumps because it makes a good seal washer, in differential thrust washers because of its wear resistance, in power steering for its light weight and rigidity, in starting and lighting equipment because it is an excellent electrical insulator and machines like a breeze.

Synthane might be a material you can use. The Synthane Catalog will help you decide. Send for your copy. Synthane Corporation, 6 River Road, Oaks, Penna.



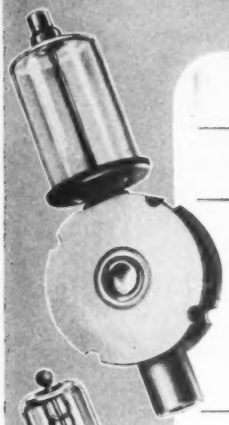
Autolite distributor uses laminated plastics in 6 places. (1) and (2) *insulating angle and bushing on breaker arm*, (3) *condenser seal washer*, (4), (5), (6) *insulating washers.*

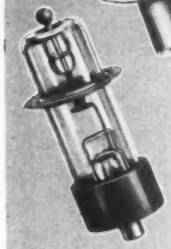
Synthane—one of industry's unseen essentials

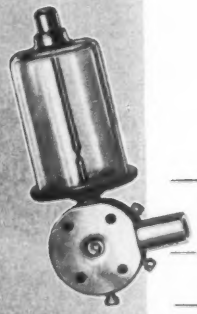
SYNTHANE
LAMINATED PLASTICS

Bomac FOR GAS SWITCHING TUBES

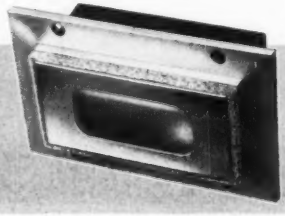
TR, ATR, PRE-TR, HYDROGEN THYRATRONS CRYSTALS AND MICROWAVE COMPONENTS

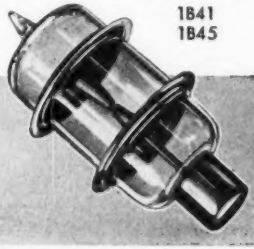






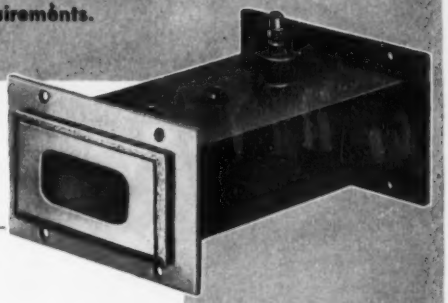
BAND	FREQ.	DESCRIPTION	TYPE
K BAND	23630-24580	TR, Integral Cavity, Tunable	1B26
	23500-24500	ATR, Fixed-Tuned, Low Q	1B36
	23350-24950	TR, Band Pass	BL-11
X BAND	9300-9450	Cross Guide Duplexer	BL-3
	9050-9600	ATR, Fixed-Tuned, Low Q	1B35
	9050-9600	ATR, Fixed-Tuned, Low Q Fast Recovery Time	6038
	8750-9300	ATR, Fixed-Tuned, Low Q	ATR388
	8600-9650	TR, Glass Envelope, Fixed-Tuned	724B
	8600-9050	ATR, Fixed-Tuned, Low Q	1B37
	8490-9600	TR, Integral Cavity, Tunable	1B24A
	8490-9600	TR, Integral Cavity, Tunable	1B60
	8490-9578	TR, Band Pass	1B63A
	8490-9600	TR, Integral Cavity, Tunable Reservoirless	BL-22
Xb BAND	6200-6700	ATR, Fixed-Tuned, Low Q	1B51
	6000-7100	TR, Integral Cavity, Tunable	1B50
S BAND	3550-3700	ATR, Fixed-Tuned, Low Q	1B52
	3400-3550	ATR, Fixed-Tuned, Low Q	1B53
	3300-3700	Pre-TR	1B54
	3250-3400	ATR, Fixed-Tuned, Low Q	1B57
	3100-3650	TR, Band Pass	1B55
	3000-3100	ATR, Fixed-Tuned, Low Q	5793
	2900-3000	ATR, Fixed-Tuned, Low Q	5792
	2870-3230	TR, Band Pass	5853
	2800-2900	ATR, Fixed-Tuned, Low Q	1B56
	2750-2850	ATR, Fixed-Tuned, Low Q	ATR387
	2700-3400	TR, Glass Envelope, Tunable	1B27
	2700-3300	TR, Glass Envelope, Fixed-Tuned	1B62
	2700-3300	TR, Glass Envelope, Fixed-Tuned	721B
	2700-2800	ATR, Fixed-Tuned, Low Q	1B44
	2650-2950	Pre-TR	1B38
	2600-3000	TR, Band Pass	1B58
	2600-3000	TR, Band Pass Pressurized System	6117
L BAND	1215-1355	TR, Glass Envelope, Tunable	BL-25
	900-1200	TR, Glass Envelope, Fixed-Tuned	1B23
	1075-1095	TR, Fixed-Tuned, Electrodeless Discharge	1B40
Ku BAND	16,200-16,800	ATR, Fixed-Tuned, Low Q	BL-15
	16,200-16,800	TR, Integral Cavity, Tunable	BL-16
SPARK GAP MODULATORS			1B41 1B45





Simplify Your Procurement Problems . . .

Bomac, leading producer of gas switching tubes, offers you a single source for TR, ATR, Pre-TR and Attenuator Tubes, Pressurizing Windows, Hydrogen Thyratrons, and Crystals. Why not simplify your procurement problems? Make *Bomac* your ONE source for all of your special requirements.

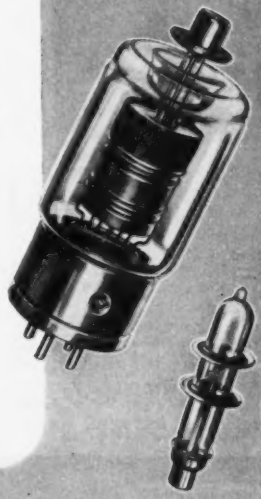


HYDROGEN THYRATRONS

Type	Peak Anode Voltage	Peak Anode Current	Average Anode Current	Peak Trigger Voltage
	kv max.	*amps max.*	*ma max.*	*volts min*
3C45	3.0	35	45	175
4C35	8.0	90	100	175
5C22	16.0	325	200	200

PRESSURIZING WINDOWS

TYPE	FREQUENCY	DESCRIPTION
BL105	9375	Pressurizing Window RG 51/u Guide
BL106	9245	Pressurizing Window RG 52/u Guide
BL107	9310	Rectangular Window RG 51/u Guide
BL114	9310	Pressurizing Window RG 52/u Guide
BL112	9080	Pressurizing Window RG 52/u Guide



CRYSTALS — Silicon Detectors & Germanium Diodes

To meet the growing demand for Germanium and Silicon crystals, Bomac now is in limited quantity production. Availability to industry will be announced at a later date. . . .

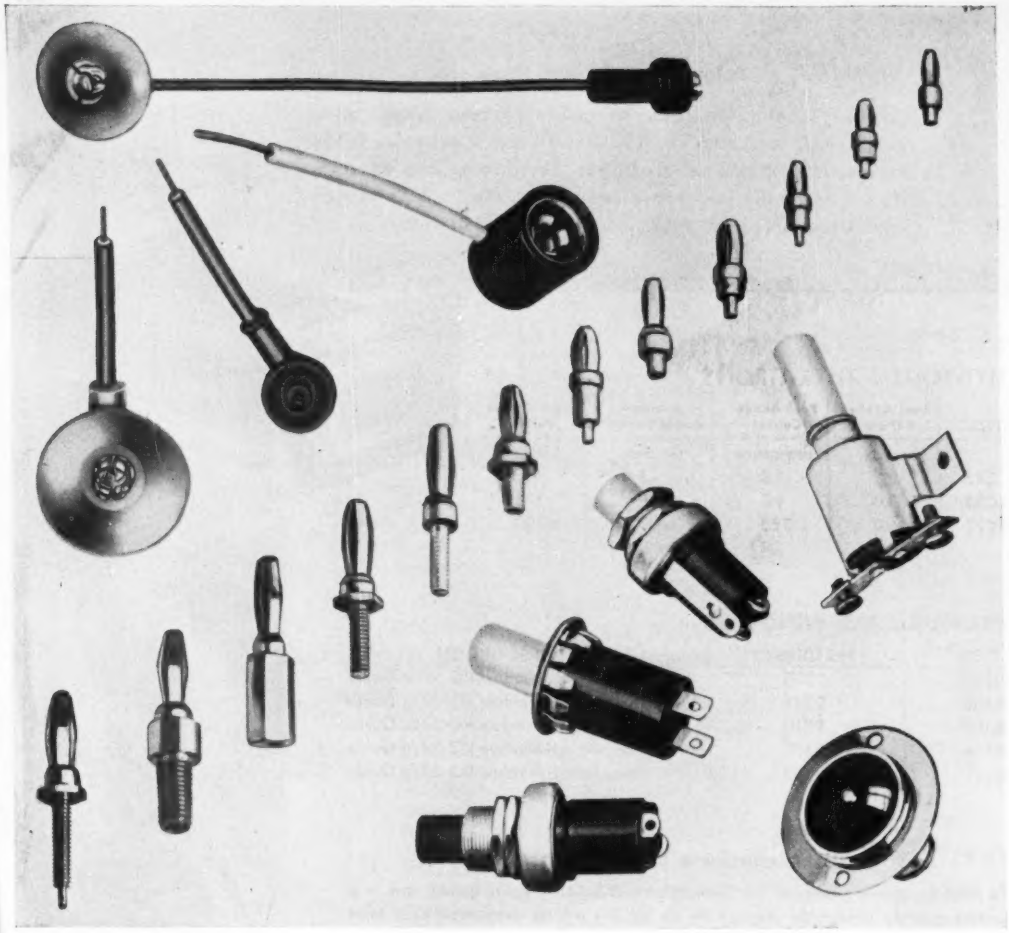
We invite your inquiries regarding

- **ENGINEERING**
- **DEVELOPMENT**
- **PRODUCTION**

Illustrated catalog available upon request. Write today on your company letterhead.

Bomac LABORATORIES, INC.

DEPARTMENT E-1
BEVERLY, MASSACHUSETTS



Precision Pays

Precision has always been a watchword at Ucinite . . . precision in design and precision in manufacture. It pays off in the high quality and dependable performance of Ucinite-designed, Ucinite-made electrical components.

Connectors, switches, sockets . . . shock mounts, tube caps, stampings and moldings of many kinds can be manufactured in volume, assembled and wired to your specifications.

Our design staff has had wide experience in catering to the special needs, both civilian and military, of the electronics industry. Our plant is equipped both for large scale production of metal parts and for the assembly of metal to plastic and ceramic components.

Call your nearest Ucinite or United-Carr representative for full information, or write directly to us.

ELECTRICAL ASSEMBLIES Ucinite RADIO AND AUTOMOTIVE

The UCINITE CO.

Newtonville 60, Mass.

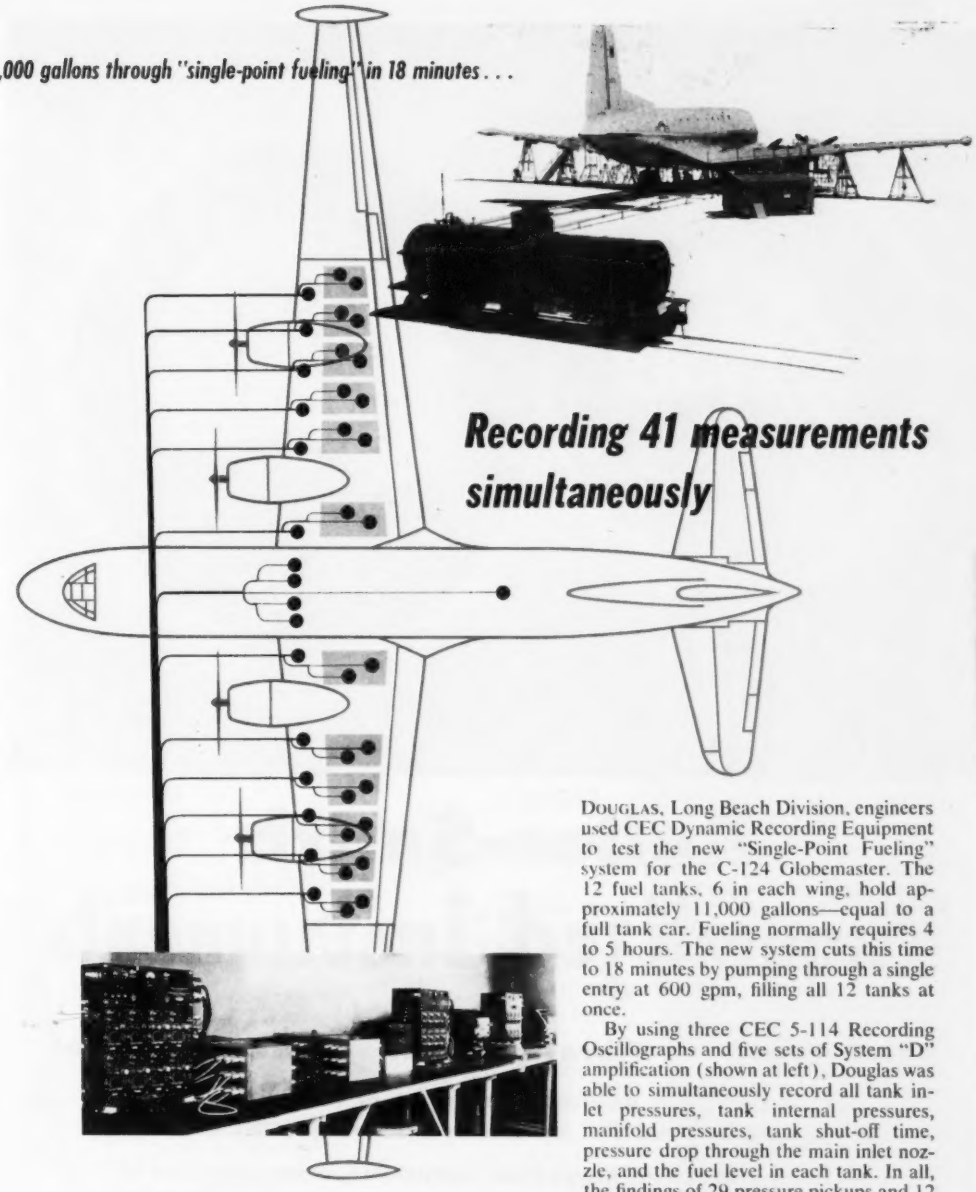
Division of United-Carr Fastener Corp.

Specialists in

ELECTRICAL ASSEMBLIES,

RADIO AND AUTOMOTIVE

11,000 gallons through "single-point fueling" in 18 minutes . . .



Recording 41 measurements simultaneously

DOUGLAS, Long Beach Division, engineers used CEC Dynamic Recording Equipment to test the new "Single-Point Fueling" system for the C-124 Globemaster. The 12 fuel tanks, 6 in each wing, hold approximately 11,000 gallons—equal to a full tank car. Fueling normally requires 4 to 5 hours. The new system cuts this time to 18 minutes by pumping through a single entry at 600 gpm, filling all 12 tanks at once.

By using three CEC 5-114 Recording Oscillographs and five sets of System "D" amplification (shown at left), Douglas was able to simultaneously record all tank inlet pressures, tank internal pressures, manifold pressures, tank shut-off time, pressure drop through the main inlet nozzle, and the fuel level in each tank. In all, the findings of 29 pressure pickups and 12 capacitance fuel gages were recorded.

Consolidated Engineering

CORPORATION

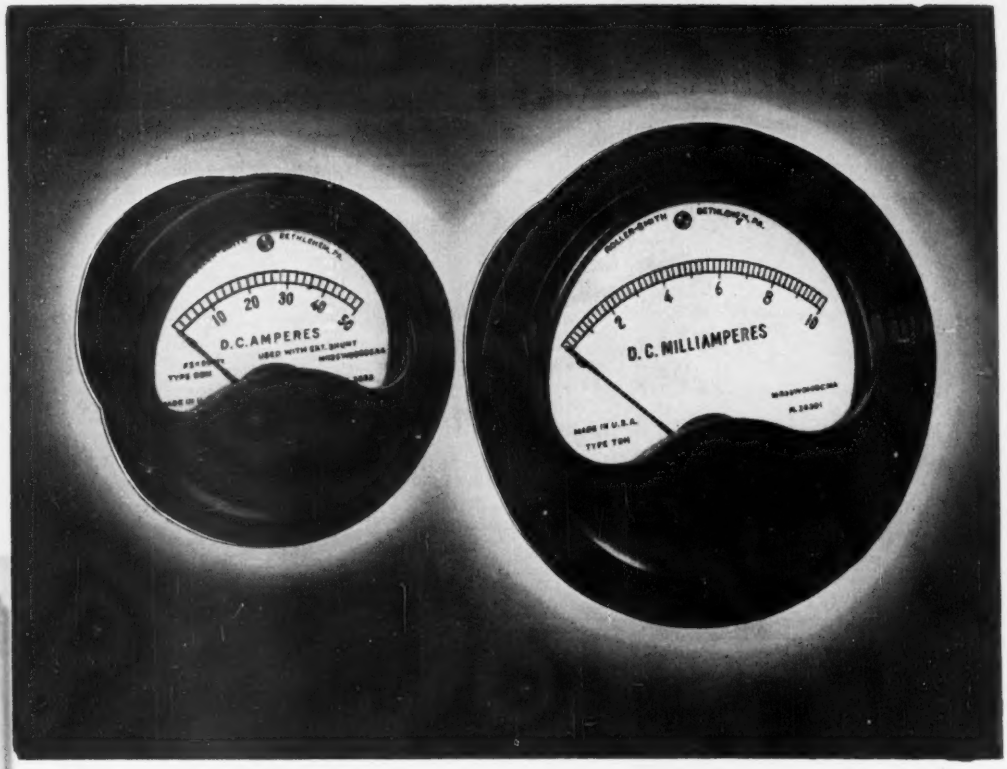
300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.** *a subsidiary with offices in: Pasadena, New York, Chicago, Washington, D. C., Philadelphia, Dayton.*

analytical instruments for science and industry

Dynamic Recording Systems

such as the one shown here are designed and manufactured by Consolidated. Variations in the arrangement of the equipment are infinite. Applications are widely varied throughout industry and the sciences. A typical recording system includes pickups, amplifiers or bridge balances, and a recording oscillograph. Write for Bulletin CEC 1500B.



Roller-Smith
Ruggedized Instruments

Shock-Proof • Vibration-Proof • Weather-Proof

Roller-Smith announces production of hermetically sealed *Ruggedized* 2½" and 3½" instruments conforming to MIL-M-10304.

In addition to *Ruggedized* instruments, a complete line of hermetically sealed and unsealed types in conformance with Government specifications are available.

ROLLER SMITH

ROLLER-SMITH CORPORATION
BETHLEHEM, PENNSYLVANIA

Getting the message through with PRECISION POINT-TO-POINT COMMUNICATION EQUIPMENT

Every increase in the scope and tempo of events makes its new, more stringent demands of communications science.

Urgent yesterday, today even higher speed, fidelity and dependability—under even tougher conditions—are *vital*. Only continuing advance in modern precision point-to-point communication equipment can accomplish these feats.

Through constant research and exacting manufacture, Northern Radio keeps its lead in supplying our and Allied government and commercial agencies with the foremost in communication equipment.

Write for complete information.

FREQUENCY SHIFT KEYERS
MASTER OSCILLATORS • DIVERSITY RECEIVERS
FREQUENCY SHIFT CONVERTERS • MULTI-CHANNEL TONE SYSTEMS
TONE KEYERS • DEMODULATORS • RADIO MULTIPLEX SYSTEMS
MONITORS • TONE FILTERS • LINE AMPLIFIERS

Pace-Setters in Quality Communication Equipment

NORTHERN RADIO COMPANY, inc.

147 WEST 22ND STREET, NEW YORK 11, NEW YORK

The Electric Candy Floss Machine Co.

"A pink cotton candy machine rheostat must provide exact temperature control"

says John G. Pettyjohn, John G. Pettyjohn Company, Knoxville, Tennessee, representative for Ward Leonard Electric Company.

Spinning sugar into fine, fluffy floss for pink cotton candy requires precise heat control. Unless a high degree of heat is closely controlled, candy becomes too thick or too thin. Since these machines are used at circuses, traveling carnivals, resorts, and similar places, machines must be ruggedly built. They must also be able to compensate for variance in voltage and surrounding temperature, depending upon the location.

The Electric Candy Floss Machine Company, Nashville, Tenn., uses Ward Leonard VITROHM plate rheostats in the heater circuits on the spinner heads of their new super deluxe candy floss machines for two reasons: (1) VITROHM rheostats are the only rheostats they have found that would stand up and give good service, (2) they are able to get a much better grade of candy.

Ward Leonard rheostats are available in several multiples of resistance values to meet various operating conditions. Special purpose rheostats requiring non-standard values and tapers can also be supplied.

Our engineering department is always ready to work with you to design the most economical rheostat for your particular application. Write for Rheostat Bulletin 60A.

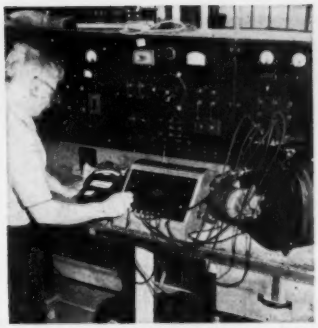
WARD LEONARD

WARD LEONARD ELECTRIC COMPANY

MOUNT VERNON, NEW YORK

Result-Engineered Controls Since 1892

ERICK SCHNEIDER, a company employee for over 23 years, operates a hydraulic press for securing the bushing assembly to the rheostat base plate.



MOTOR-DRIVEN RHEOSTAT undergoes a thorough electrical test prior to final inspection. Ian Scott, a company employee for 17 years, is the electrical tester.

VITROHM rheostat construction assures smooth, precise control and long life

Five features of VITROHM rheostat construction important to efficient operation are:

(1) Pressed steel plate forms a rigid, durable, but lightweight base.

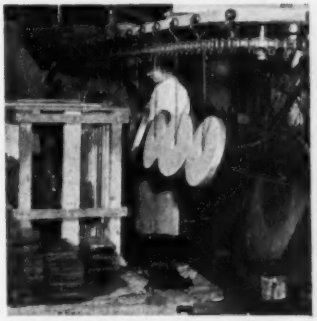
(2) Resistance element of special alloy wire, of low temperature coefficient of resistance assures permanent resistance values.

(3) Stationary contacts are solidly anchored to the resistance element by a patented Ward Leonard process assuring a perfect junction.

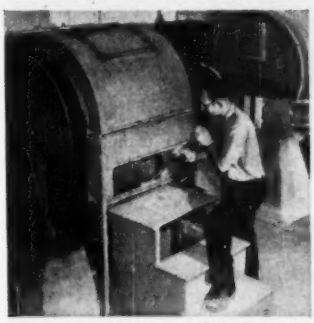
(4) Movable contact is made of solid metal graphite having self-lubricating properties for smooth operation.

(5) VITROHM insulation applied over the resistance wire holds the wire and contacts in place and protects them against corrosion, mechanical damage.

Consult Ward Leonard on the adaptability of standard or modified electric controls to meet your particular needs.



HEAT-RESISTANT FINISH is automatically applied and infrared baked. Arthur Vasold removes finished plates and loads sandblasted plates on continuous conveyor.



REVOLVING BALL MILLS grind the frit to the exact fineness needed to produce the perfect vitreous enamel used in the manufacture of the VITROHM rheostat.

DISTRICT OFFICES AND REPRESENTATIVES

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Give enough!
THROUGH YOUR COMMUNITY CHEST

CROSS TALK

► **COLOR** . . . Lifting of the freeze gave the television industry a shot in the arm that will keep it very much alive and kicking for many years. And when the rejuvenated body again begins to slow down along will come more adrenalin in the form of color; there may even be a modest injection before the arteries show serious signs of hardening.

It now seems certain that when color comes again it will be compatible. People who have monochrome sets will be able to watch programs transmitted in color without buying accessories. They will, of course, see these programs in monochrome. If they want to see color programs in color they will probably buy a new set. And there is no reason to suppose that this necessity will be widely resented. People always have been willing to spend more money for more service, in this and every other business.

Already several companies operating tv stations are quietly air-testing compatible color on their own hook. There are still some bugs but these appear to be minor. Next step will be coordination of test results and proposal of just about universally approved standards to the FCC.

The second coming of color should please the public, the government and the industry, in timing as well as in result.

► **TURNABOUT** . . . Sooner or later, export business will once again become as important to American manufacturers of electronic equipment as it was before the war and subsequent domestic shortages. When this time comes, much of our ability to sell merchandise abroad will depend upon how many dollars foreign customers can scrape up. And this, in turn, will depend largely upon what they can sell us to get the necessary exchange.

Exports are inevitably tied to imports. Countries that facilitate one kind of business are very likely to get the other.

► **HANDICAP** . . . Speaking of imports, several firms selling European-made electronic equipment in the U. S. tell us it is not the easiest job in the world to secure Underwriters' approval. Checking, we find that this is true. Foreign equipment is gone over with a particularly critical eye, and this process takes time and costs money.

We can think of several reasons why charity, if any, might begin at home when equipment is examined for possible fire hazards. But there is one aspect of the inspection routine which seems almost too pat. Equipment hooked up with European-made wire is generally disapproved; foreign manufacturers apparently have to buy our insulated wire if their gear is to receive the seal of approval.

It seems very curious indeed that insulated wire made in Europe should seemingly have at least two strikes against it before coming to bat. Surely all of the wire made overseas is not as bad as that.

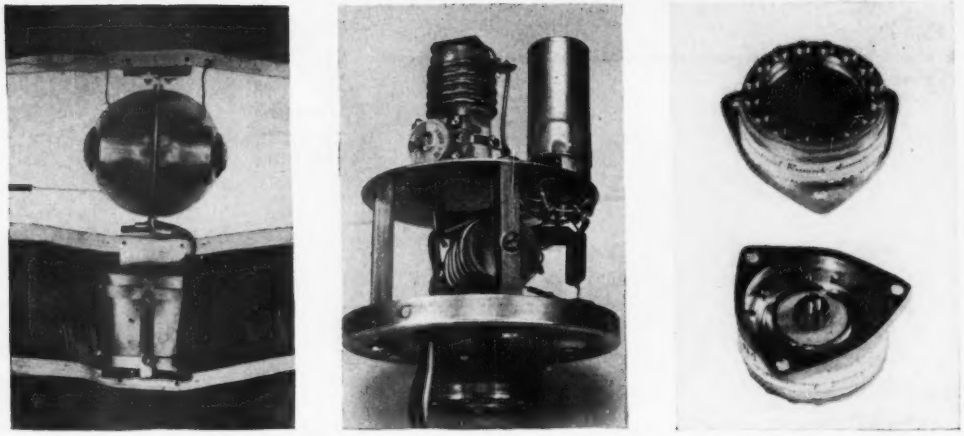
► **NAMES** . . . "Reliable" tubes have now become "military" reliable tubes, "commercial" reliable tubes and "electronic industry" reliable tubes. There are also "reliable-rugged" tubes.

A reliable tube may or may not be ruggedized, depending upon whether it has been engineered to withstand extreme shock or vibration. A ruggedized tube may or may not be reliable other than with respect to its ability to withstand shock or vibration.

All this trick terminology is very confusing. In the end it is the same old story of picking the right tube for the right job and then using it in the right way.

► **UP** . . . Business is good with ELECTRONICS. So we are ploughing more and more material into the book for the reader.

This issue contains 22 (count 'em) feature articles, plus expanded departments. We think it really covers the waterfront in our fast-moving field and hope you do too.



Construction details of transmitters and microphones used in target to detect misses. At left is complete two-microphone transmitter unit mounted in plastic ball set into window of airborne flag target. Battery case is below sphere, and the two antenna wires are woven through the flag. Center—closeup of one transmitter, with microphone mounted under its base. Right—details of rugged capacitor microphone used, having extremely close spacing of diaphragm from case to get high sensitivity

Acoustic Firing Error Indicator

By MARCUS C. ELIASON*

Hughes Aircraft Co.
Culver City, Calif.

and W. G. HORNBOSTEL*

International Research Associates
Santa Monica, Calif.

AIRBORNE TARGETS used to simulate a plane have been chiefly flags, sleeves or gliders towed at the end of several thousand feet of cable by a special towing plane.

The number of actual target hits which can be made in training on such targets is an extremely small fraction of total rounds fired.

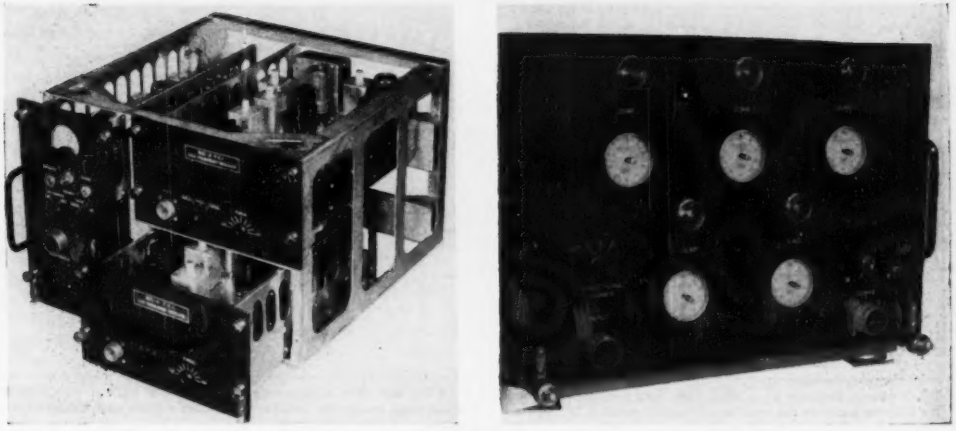
The firing error indicator described gets training value from misses by indicating errors of aim directly to the marksmen both in ground-to-plane and plane-to-plane shooting at airborne targets. It came as the result of certain ideas originating with members of the staff of the California Institute of Technology who had witnessed Army target practice in connection with other war research work, so that their attention was forcibly called to the existence of the problem. The idea was carried through development and production stages at Caltech during World War II under NDRC contract OEM sr 600.

* Formerly with Air Associates Inc., Teterboro, N. J.

As long as their speed relative to the air mass substantially exceeds the speed of sound, projectiles send out from their trajectories acoustic waves known as ballistic shock waves. The intensity of the ballistic shock waves existing at a given point in the air is a characteristically diminishing function of the distance from the trajectory. In the firing error indicator, two microphone-and-transmitter units are mounted in the airborne target and linked by radio with a radio receiving station near the gun. The target-borne units send quantitative signals to that station indicative of the intensity of the shock waves from the bullets as they pass in the vicinity of the target. These signals are interpreted at the receiving station by automatic means as projectile distance and direction from the target for each miss or hit.

Two f-m receivers placed near the gun detect the radio signals and convert the frequency modulation into brief audio voltage pulses proportional to the response of the microphones to the shock wave. These pulses are suitably amplified and pulse-lengthened to give visual indications and permanent records. Since the radio-frequency excursion from the carrier value corresponds to shock wave amplitude, the telemetered measurement is independent of transmission conditions so long as the input signal level is sufficient for limiter saturation.

The two pulse-lengthened audio signals, proportional to the responses of the two microphones, are electrically added to form the sum response, which is taken as a measure of the miss distance. The difference in time between the two microphone signals is taken as an indication of the side of the trans-



Receiving and indicating equipment used either at ground location or in accompanying observation plane. Three-chassis unit contains the two receivers one above the other, with the computer chassis at their left. Indicator is separate unit, shown at right. Computer adds the two audio output signals to get miss distance in three zones on upper three counter dials, and subtracts for direction of miss, shown on lower two counter dials as count of lead and lag shots

Microphones at opposite ends of plastic sphere in towing-sleeve target respond to ballistic shock waves and modulate tiny f-m transmitters. Two receivers near gunner actuate indicators that show miss distance and tell if gunner is leading or lagging

mitter on which the bullet passed.

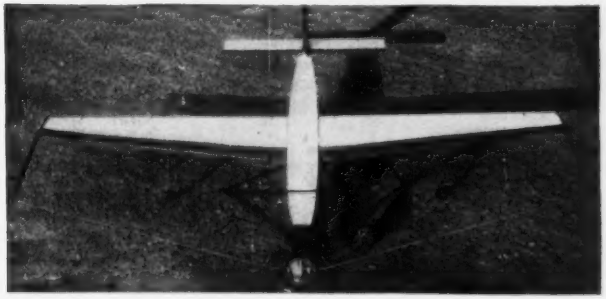
In the receiver unit, circuits provide two directionality-indicating channels corresponding to the two microphones in the transmitter. The coupling is such that a signal appears at the output only in that channel which received the earlier of the two microphone signals, the signal in the other channel being completely blocked.

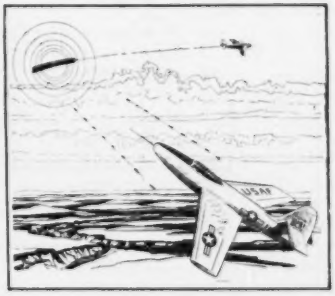
Adjustable thresholds are provided in the receiver in such a manner that the sum signal is, according to its intensity, routed into one or more of three different sum channels. Choice of these thresholds establishes in the target area substantially circular concentric sum response zones.

Each transmitter is a master oscillator-power amplifier using a 3A5 double triode. The microphone is mounted on top of a cylindrical box which shields the oscillator components. Carrier frequencies used are 56.75 mc and 55.5 mc.

Receiving Station

The block diagram of the receiver unit is shown in Fig. 1. The antenna cable feeds a tee connector from which quarter-wave 100-ohm cables lead to the antenna coils of the two receiver channels. Each antenna coil is matched to





Two examples of firing error indicator installations. When used in 16-foot target glider, antenna wires run from plastic sphere back to outriggers on wing tips. Antennas for towing-sleeve installation are woven into cloth. In both uses, the receiving station is located in the tow plane, and error information is relayed on a command set to each fighter pilot in turn as he makes passes at the target

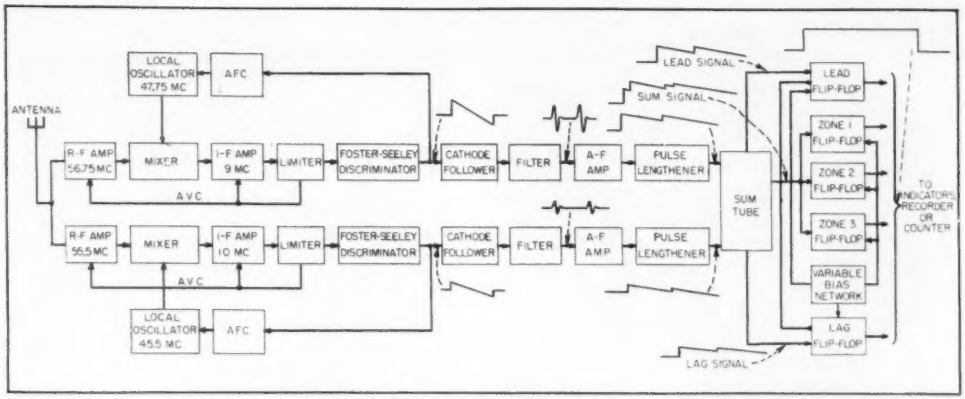


FIG. 1—Block diagram of receiver unit. Two separate f-m receivers feed the sum tube in the computing section in such a way that the five outputs indicate the number of bullets passing through each of three miss zones, the number of leading misses and the number of lagging misses

this same impedance for its own signal frequency. For the signal frequency of the other channel, however, the antenna coil presents a terminal impedance of only about 15 ohms and hence rejects signals of that channel.

Two separate local oscillators and two different i-f values are used to permit individual automatic frequency control of the two channels.

The gain of the i-f amplifier is maintained over a wide range of input amplitude fluctuations by the use of avc fed back from the first limiter and by the operation of the two-stage limiter itself.

The discriminator output voltage is also used to furnish automatic frequency control to the local oscillator. Moderately slow drifts of transmitter frequency are automatically followed so as to maintain the i-f signal in the receiver at the correct value.

After suitable impedance transformation in the cathode follower stages, the a-f signals pass through audio bandpass filter networks which are 3 db down from mid-band value at 4,000 and 10,000 cps respectively. The filters eliminate low-frequency noise and disturbances but retain the two discontinuities of the shock wave[1] in the form of two transient pulses, as indicated on the block diagram. These pulses do not usually coincide in time in the two channels because the two microphones on opposite sides of the spherical case in the transmitter unit seldom receive the shock wave simultaneously. This time displacement, which may be in the order of one millisecond, would prevent addition of the two microphone signals to form the sum response unless pulse lengthening is used.

Computer and Indicators

Figure 2 shows one channel of the audio amplifier and the sum-

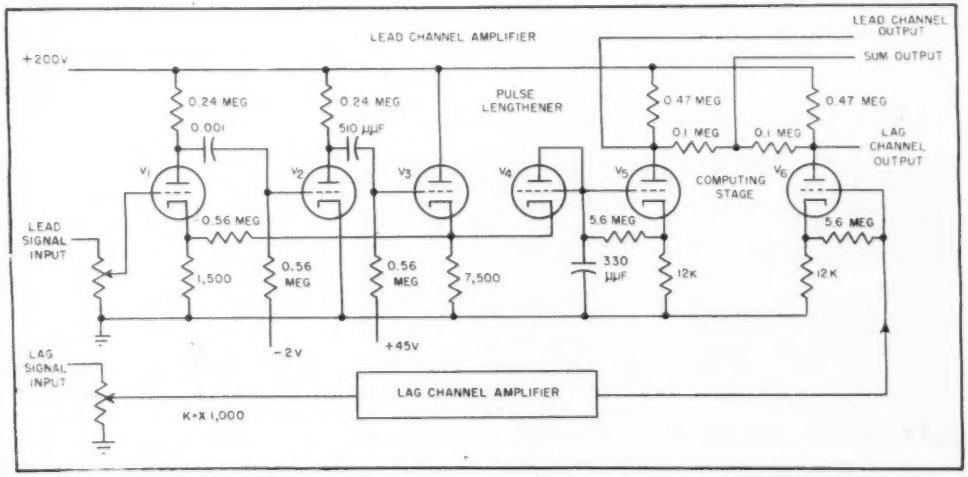


FIG. 2—One channel of audio amplifier in a receiver, and sum-difference computing stage serving both receiver channels

difference computing stage. The audio amplifier uses negative feedback with a certain amount of direct coupling and small time constants to flatten the response, give stable amplification and provide a very low impedance output to drive the pulse-lengthening diode which connects to the sum tube. The lengthened pulse exhibits a delay to half its initial peak value in approximately six milliseconds. Since the tops of lengthened pulses are nearly constant for a few milliseconds, the signals from the two channels may now be combined in a sum tube or computing stage. The sum of the two pulse-lengthened signals is a superimposed exponential pulse, as indicated in Fig. 1.

For purposes of scoring, it is desirable to classify the shock-wave signals as having fallen in three concentric miss distance zones of predetermined radii. This function is performed by the zoning flip-flops.

Whenever the sum signal exceeds a certain amount, one of the zoning flip-flops will trip and furnish, for a standardized length of time, a plate signal which can be used for recording equipment or for use with a mechanical counter. The peak value of input pulse at which flipping occurs is adjustable by means of bias potentiometers; with these, the sizes of the miss-distance zones of a target can be set for a given calibre of ammunition.

Two more flip-flops are so interconnected that one or the other trips according to which microphone channel receives its signal first. The receiver output thus contains five channels, one or more of which are activated as the bullet passes through the three miss distance zones and two directionality zones. These five channels may be connected to indicating devices such as a tape recorder or a counter.

The Microphone

The heart of the system is a specially designed and carefully built capacitor microphone having a response characteristic flat to within plus or minus 1 db from 0 to over 10,000 cps. The construction is such that it will withstand repeated application of 200-G shocks without damage or change of characteristics. Response is linear to within 5 percent up to an applied pressure of 30,000 bars, which is 0.44 lb per square inch. A relief vent in the microphone permits use at any air pressure from sea level up to 10,000 feet of altitude with no serious change in its characteristic.

The microphone diaphragm is made of 0.0016-inch beryllium copper. The diaphragm-supporting casting is a special bronze selected to have essentially the same coefficient of expansion as the diaphragm material, so that the temperature coefficient of the sensitivity of the microphone is negligible.

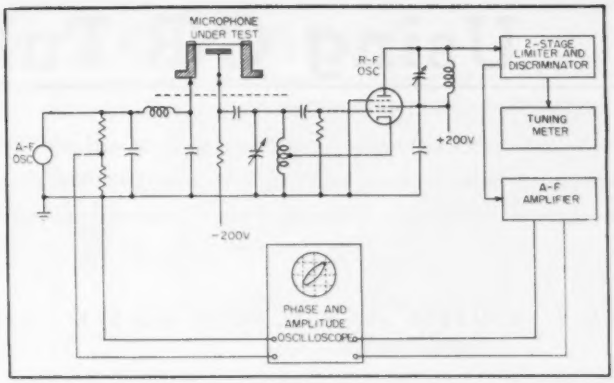


FIG. 3—Simplified diagram of electrostatic microphone tester used in production-testing the special flat-response microphones required

Microphone Testing

The electrostatic microphone tester circuit shown in Fig. 3 uses the microphone as part of a tuned r-f oscillator circuit. By applying an a-f voltage from a low-impedance source to the microphone and simultaneously applying a d-c polarizing voltage to the insulated electrode button of the microphone, it is possible to make the diaphragm move at the a-f rate by electrostatic attraction. This correspondingly varies the capacitance that the microphone introduces in the r-f oscillator grid circuit.

The a-f oscillator voltage is simultaneously fed to the horizontal plates of an oscilloscope. The r-f oscillator voltage, which becomes frequency-modulated by the a-f voltage, is fed through a two stage-limiter, discriminator and a-f amplifier. The resulting a-f output is fed to the vertical plates of the same oscilloscope. The voltage between the horizontal and vertical plates is compared for phase angle. When the microphone is critically damped, the only way in which the resonance point of the diaphragm can be determined is by using the criterion that when it is at resonance, the diaphragm movement is 90 degrees out of phase with the applied voltage. This makes it possible to duplicate microphones under production conditions. The response of the microphone to the electrostatic deflection is essentially identical to that which will occur if the microphone were acoustically excited.

Since the original development of the acoustic firing error indicator equipment, this device has been produced in large quantity by electronic equipment manufacturers for use by the Armed Services.

The successful development of the equipment described was to a very large extent due to the able direction and efforts of J. W. M. DuMond of California Institute of Technology, who was project coordinator, and W. K. H. Panofsky, now at Stanford University, who was project director.

Reference

(1) J. W. M. DuMond, E. R. Cohen, W. K. H. Panofsky and E. Deeds, A Determination of the Wave Forms and Laws of Propagation and Dissipation of Ballistic Shock Waves, *Jour. Acoustical Soc. America*, p 97, July 1946. This paper was the result of field studies of ballistic shock waves in conjunction with development of firing error indicator equipment.

Using C-R Tubes With

Use of pole-piece extensions built into neck of cathode-ray tube reduces magnetic energy required to achieve focus and minimizes astigmatisms due to nonsymmetrical fields from the external focus unit. Different types of internal pole pieces and their use in e-m and p-m picture tubes are discussed

By C. V. FOGELBERG and E. W. MORSE and **By S. L. REICHES and D. P. INGLE**

National Video Corp.
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All Star Products Inc.
Defiance, Ohio

IN ATTEMPTS to reduce the consumption of critical materials in television receivers, much attention has been paid to the focus system of the picture tube. The electrostatically focused tubes represent one means of saving copper and Alnico. However, it has become apparent that other material-saving focus systems would be desirable.

Design

Work on this problem has led to the development of the magnetically focused picture tube that uses internal magnetic pole pieces to form the focus lens. The use of these poles has reduced the external focus energy requirements by 36 to 65 percent, depending upon the particular pole-piece design and upon the type external-focus device used. Further, due to control of aberrations in the focus lens, picture quality has been improved beyond that of the conventional magnetic and electrostatic-focus tubes.

It has long been clear that the conventional magnetic focus system is inefficient owing to the fact that much of the magnetic circuit is in air or vacuum unnecessarily since the region in which the electron beam must enter the field is relatively small. By providing a comparatively low reluctance path for the magnetic flux inside the tube, it is possible to produce a sufficiently strong magnetic field near the beam with greatly reduced amounts of magnetomotive force.

The magnetic circuit that has been developed has one unavoidable high-reluctance gap due to the glass neck thickness, and one other gap near the beam where the magnetic lens is formed. In the focus-lens gap, the diameter of the apertures in the pole pieces was made as small as possible to give the greatest reduction in magnetomotive force necessary to focus, but large enough to prevent beam masking. The length of the lens gap was determined by other considerations, which will be discussed below. The aperture diameter and the gap length chosen determine the reluctance of the lens gap. The separation of the poles of the external source of magnetomotive force determines the length of the pole-piece assembly, since these must be coupled to the external poles with minimum air gap to give minimum gap reluctance. For the same reason, the inner diameter of the external poles should be held to a minimum to reduce the reluctance of the gap between them and the inner pole pieces.

A simplified consideration of the effect of the length of the focus lens gap on the required amount of magnetomotive force shows that the change ought to be directly proportional; increasing the gap length increases the magnetomotive force necessary. This would be expected since the effect of increasing any gap would be to increase the reluctance of that gap.

A series of pole pieces was constructed in which the length of the gap was varied in 1/16-inch steps, and all other parameters were held constant. A graph of the focus current required for these various gaps, all at the position of best coupling between outside and inside poles, is shown in Fig. 1.

The results shown confirm the conclusions drawn above. Since reluctances vary as the inverse of the area of the gap, it might be expected that energy requirements would also vary as the inverse of

Early design of internal pole piece for mounting atop anode barrel

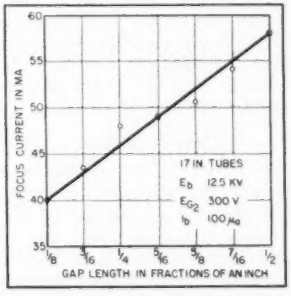
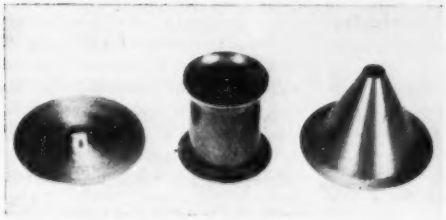
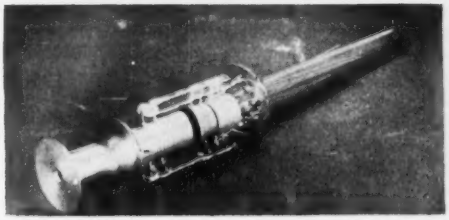


FIG. 1—Focus current for different gap lengths

Internal Pole Pieces



Later internal pole piece uses flat-plate front pole to reduce shielding of focus lens and allow shifting of field for centering



Photograph shows flat-plate pole piece mounted on crt gun before insertion in cathode-ray tube

the gap area. This was found not to be true. The explanation of this lies in the fact that the flux effective in focusing the beam is essentially leakage flux between the two poles. Removing the two poles from this region by increasing the aperture diameter increases the energy required to produce a given lens.

Positioning

Since outside support of the magnetic source might be necessary, it was deemed desirable to locate the lens at the same general region in which the present focus devices are located. This further avoids insulation problems since this is a region essentially free from electric fields.

In previous magnetic-focusing systems that located the focusing device near the deflection system, an interaction between the focusing field and the deflection fields was unavoidable. The fact that the focus field in the pole piece tube is largely confined to the low-reluctance pole-piece region reduces this problem to a minimum. A shortening of the anode barrel further reduces field interaction.

In addition to energy requirements, consideration of the relative centering motion available with different pole pieces is important. Centering of the beam is often obtained by shifting the axis of the magnetic field with an outside slide pole piece. When this sort of device is used with a pole-piece lens, the shielding effect of the pole pieces tends to smooth out the effect of shifting the outside pole to the point where insufficient centering motion is available. The longer gap lengths tend to increase centering motion but increase the energy requirements as noted above. This difficulty is avoided by displacing the outside focus device toward the face of the tube. This produces sufficient flux for centering without greatly increasing the energy requirements. A displacement of about one-eighth inch to the front of the front pole piece was found to give good results.

The shorter gap lengths require extremely careful alignment of the outside pole pieces of the focusing device with the internal pole pieces, and were, therefore, deemed impractical despite the lowered reluctance of the lens gap. Various types of internal pole pieces are shown in the accompanying photographs.

The photograph shows a pole piece designed to be mounted on top of the anode barrel. With this early design it was noted that insufficient centering motion was possible with the slide-pole device used. This is to be expected since the change in field produced by the slide pole is largely smoothed out near the lens, and little stray field exists on the screen side of the gun. An independent centering device is commercially undesirable.

The more recent flat-plate front pole design (see above) reduces the shielding of the focus lens, and allows a shifting of the magnetic field to affect the beam sufficiently to provide adequate centering. This reduced shielding works in conjunction with added stray field in front of the front pole piece.

A gratifying result of this work was the improved picture quality caused by reduced aberrations of a focus lens produced by means of pole pieces as compared to a lens produced by wholly external focus devices. Flux lines are linearly distributed. Nonuniformities of the focus magnet's field have been smoothed out by the pole pieces producing an essentially nonastigmatic field near the beam.

Focus devices for use with the pole-piece tube may be either permanent or electromagnetic in design. Both kinds have been built and give excellent results.

Production tolerances for pole-piece tubes are, in general, wide. The variations in gap length produced by common tolerances used in stamped electron gun parts are almost unnoticeable. Standard tolerances for aperture diameters hold, as is true for aperture concentricity. Alignment of the pole pieces on the axis is important, but is easily attained with proper assembly fixtures.

Attempts to redesign the focus system of magnetically-focused picture tubes have led to a focusing system that requires greatly reduced amounts of magnetomotive force. This result may be translated into greatly reduced consumption of critical materials and picture tubes giving noticeably

Application

better performance without increased manufacturing difficulties.

Internal pole-piece material is generally cold-rolled steel between 0.010 and 0.020-inch thickness. Low-carbon irons, however, have the advantage that their permeability is almost independent of the direction of rolling whereas in cold-rolled steel there may be as much as 20 percent difference between the axis of rolling and that at right angles.

Centering of a tube with internal pole pieces requires that displacement of the electron beam be done in front of the pole piece closest to the face of the tube. If the beam is displaced in the area between the pole piece closest to the face of the tube and the base of the tube, cutting of the beam by the various apertures takes place. It has been found that if an internal-pole-piece configuration such as shown in Fig. 2 is used and a slide pole arranged on the external focus unit, centering of the picture follows the conditions plotted in Fig. 3. These curves show the amount of centering as a function of the displacement of the slide pole piece on the focus unit with respect to the front internal pole piece. This data is presented for two second-anode voltages.

It is seen here that the position of the slide pole for maximum centering is not the position for the most efficient coupling. The percentage of flux carried by the slide pole as compared to the fixed pole mounting the slide pole is a factor controlling the amount of centering available. In the designs found practical the largest percentage of the flux is carried by the slide pole. This is the reverse of the general case in the conventional p-m unit.

The amount of centering motion shown is possible only if the front pole piece (the one closest to the face of the tube) is substantially a flat plate. Tubes that use two truncated cones to form the internal pole pieces are generally found to be a little more efficient magnetically but as a rule do not allow adequate centering motion.

The length of the magnets chosen for these focus units seems optimum for the conditions of use, but it is possible that with further tube development, the spacing between the internal pole pieces will not be such that the back poles will be in alignment for maximum coupling. On this account, a sleeve is inserted in the back pole piece of the focus unit to allow a fairly large displacement along the neck of the tube without losing coupling between the back pole pieces. This rearward-pointing sleeve may be so arranged that part is inside the focus unit if tube design tends to place internal pole pieces very close together.

Basic Types

Practical p-m focus units for these tubes have evolved as two basic types, the pilaster-mounted and the neck-supported types shown in the photographs.

The pilaster-mounted type is rigidly supported by the same assembly holding the deflection yoke in conventional practice. The mounting is designed so that the unit has the proper relationship to the internal pole pieces for magnetic coupling and for proper centering conditions.

Focus is controlled by turning the focus control knob, (Fig. 2) which moves the annular ring forward and back to change the shunting effect on the magnets.

Centering is achieved by displacing the slide pole using the slide-pole extension. This unit is used and handled in the same way as is the conventional p-m unit, except that care must be exercised in placement along the neck of the tube.

To facilitate this positioning, which is important in both types of units, the tube manufacturers who will position the internal poles relative to the reference line intend to also provide either a window in the Aquadag or an external mark on the tube as a quick guide for positioning.

The neck-supported type of unit was the original design approach and came about because of the economies involved, both in construction and in mounting ease.

Control of focus with this unit is achieved by moving the entire flux-producing part of the assembly along the neck of the tube. By doing this the air gap between the external and internal pole pieces can be varied and focus controlled. Centering is again controlled by the slide pole. The data shown in Fig. 2 also hold for this design. A sleeve in the back pole piece is used here also to allow displacement between the front pole pieces at all times and still allow focus control by moving the whole assembly.

It has also been found that this sleeve gives a smoother control over focus since only one air gap is changed as the unit is moved.

A unit of the neck-supported type weighs about 6 oz, depending some-

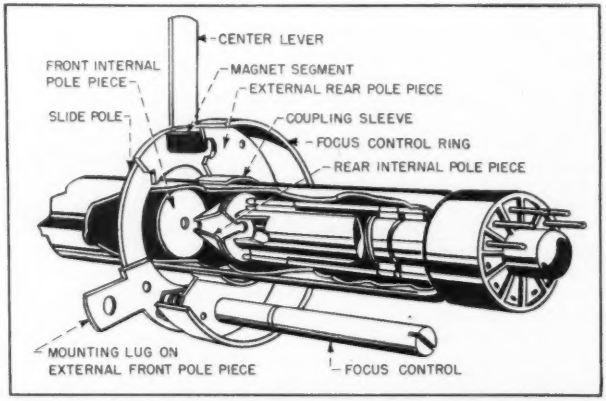


FIG. 2—Drawing shows typical positions of internal pole pieces and focus unit mounted externally on neck of tube

what on the magnet requirements. Initially, it was believed this was too much weight to put on the neck of a tube. However, one receiver manufacturer has investigated this point and is of the opinion this weight is safe.

Mechanical Problems

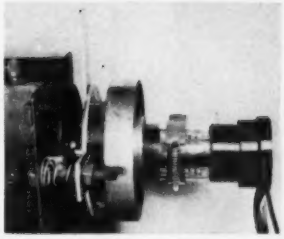
While the design of the pilaster-mounted type of unit was straightforward several problems had to be solved with the neck-supported design.

Even with internal pole pieces it is not desirable to bring the three magnet segments used close to the neck of the tube for reasons of stability. Close spacing aggravates the tendency of the unit to displace sideways during focusing and centering causing the entire picture to wiggle.

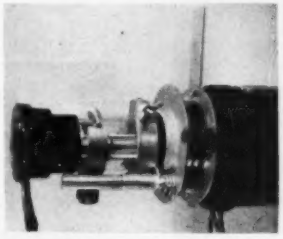
By means of close-fitting guides the neck supported unit shown has a stability during focusing and centering that is entirely satisfactory even with the magnets at some distance from the neck of the tube.

Possibly one large-scale use for this type of unit is in the replacement of electrostatic tubes. Most electrostatic tube sets do not have provisions for mounting a focus unit.

One unusual effect noticed, that is probably of importance only to the engineer working experimentally, results from the residual magnetism of the internal pole pieces. If work is being done with



Pilaster-supported external focus unit for use with tubes containing internal pole pieces



Photograph shows neck-supported focus unit

focus units of reversed magnetization it is suggested the internal pole pieces be demagnetized before each test. The use of low-carbon irons for the internal pole pieces will largely avoid this. However, since the flux in the gap at the center of the tube is of the order of 20 gausses it is seen that even 2-gauss residuals, which have been found, can cause trouble. In addition, if there are areas around the aperture with unequal residual flux, the dot can be distorted. This effect has been seen on some tubes and easily remedied by demagnetizing the internal pole pieces.

The ion-trap setting has proved to be a little more critical than is found for the conventional magnetic focus, but not as critical as in the electrostatic tube. This condition is believed to come about for somewhat the same reasons as in the electrostatically-focused tube. Because the length of the magnetic lens is very short and because the aperture in the internal pole pieces is in the order of 0.150 inch it is evident that the beam-bundle axis should be as coaxial as possible with the magnetic lens so as to minimize astigmatism.

Industry Use

The saving in magnetic material in the p-m case is quite high and in the neighborhood of 65 to 70 percent over that required in the conventional magnetic case. This much saving has not appeared in the e-m case primarily because of the difference in the stray field conditions from the e-m compared to the p-m. Much more of the total energy in a conventional p-m unit is lost to stray fields than in the e-m unit.

Due to the more complete magnetic path of the internal-pole-piece tube much of the field normally stray is utilized. At this stage of the development of the e-m coil about 36-percent saving in ampere turns is achieved. This actually represents a bigger savings in copper because the reduction in copper takes place on the longer outside turns.

It is now believed correct to state that at this time there are three types of c-r tubes available to the industry: the conventional magnetic focus, the electrostatic focus, and internal pole piece magnetic type. The factors dictating the choice of tube are evident as being comparative performance, cost of tube and associated equipment and availability.

It seems that all three types will find a place in the industry but with the possibility that the ipp tube may in time displace the conventional magnetic type.

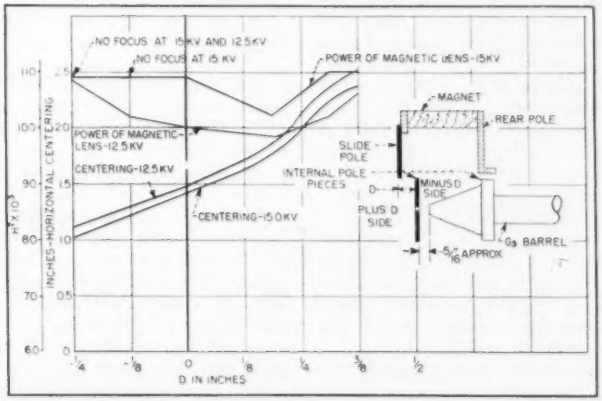
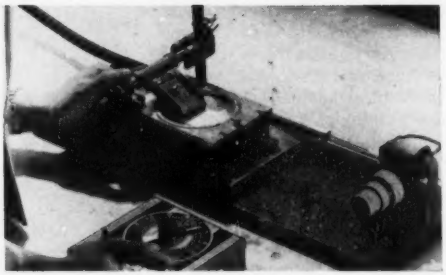
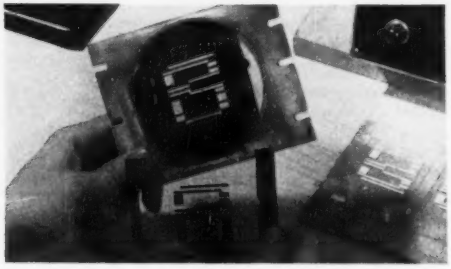


FIG. 3—Effect of alignment of internal and external poles. Minimum current point in front pole is due to rear flange of focus

Applying silver mix to screen for producing terminal areas. Techniques for resistor mixes are identical



Use of small geared-down motor to pull screen under rubber squeegee. Uniform velocity is essential for reproductibility of results



Silk screen for silver mix (left hand) and silver terminal pattern on glass plate (right hand)

Production Control

AN IMPORTANT objective to be attained in the use of a printed circuit is the reduction of production cost. This cost in any mass-production process is closely dependent on the rejection rate. A second factor is the effect of producing several circuit elements on one plate, a procedure which precludes selection and sorting of components. Relatively uncontrolled processes are rendered usable in the production of individual components by sorting 100 percent of the product into salable value groups.

The silk-screened resistor is generally intended as a replacement for fixed composition resistors and its requirements as to value, tolerance, temperature coefficient, drift, noise, life and voltage stability are at least nominally evaluated by JAN-R-11 tests. Although these specifications are not entirely appropriate since the functioning of a printed group is a more valid criterion than a blanket tolerance applied to each resistor value, it will be assumed here that the same limits are required for printed as for individual composition resistors.

Steps in Manufacture

Theoretical and experimental effort has been directed toward isolating major cases of variability in the printing process and toward optimizing the procedures. In outline, the procedure used is:

(1) Firing silver terminal areas on base plate

(2) Printing resistors with silk screen

(3) Low-temperature drying with convection

(4) Baking at intermediate temperature

(5) Curing

(6) Screening with protective coating

(7) Room-temperature drying with convection

(8) Stabilizing in convection oven

A complete cycle of manufacture exclusive of the first step (metallizing) is about 4 hours.

For silk screening of the silver terminal areas, a common commercial ceramic decorating paint was used, with consolidation of the paint by 600 C firing.

The resistor screening mixes were formulations of graphite, carbon-black, resin and a solvent. The

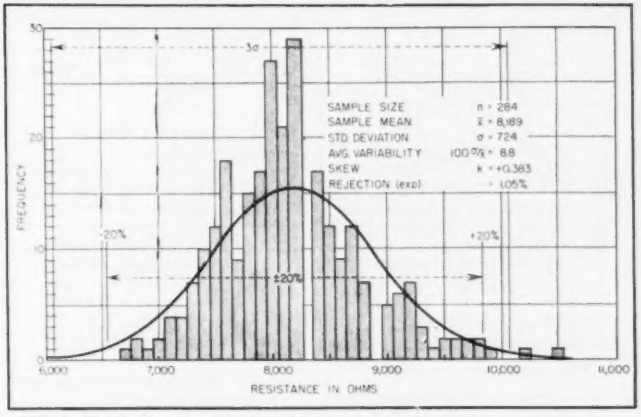


FIG. 1—Distribution of resistance values for batch of uncoated cured resistors

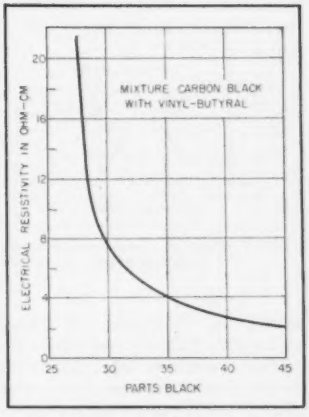


FIG. 2—Effect of carbon concentration

Analysis of factors affecting reproducibility of silk-screened resistors. To minimize final-assembly rejections, five major variables require critical control: carbon concentration, squeegee speed, screening temperature, curing temperature and overcoating

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# of Printed Resistors

binder resin is a modified styrene and the solvent a high-boiling acetate, to minimize evaporation on the screen. White shellac provides a satisfactory seal coat when overprotected with slurry-applied granular phenolic resin. While not followed in these tests, commercial practice requires a third protective layer comprising impregnation with wax.

All of the data given is for resistors screened on glass. Drying and baking were done with conventional laboratory equipment refined slightly to achieve the temperature uniformity required. Screening was done in an environment controlled to prevent temperature variations greater than ±0.5 C on the printing screen.

In Fig. 1 is shown a distribution of values for a lot of uncoated resistors several times minimum sample size, including several runs under normally varying conditions. Control of all variables in the process up to the coating step is evidenced by the small actual rejection, 1 percent at the ±20 percent limits.

Rejection Rates

The detection of fine differences representing the effects of low-order variables requires samples of considerable size. Samples of 48 or more resistors have been found necessary for maintaining a confidence level of 80 percent in most of the tests reported.

The influence of mixture concentration is shown in Fig. 2. Although this curve is for a mixture containing carbon black as the only conductive material, it is representative of the situation most frequently met in graphite, carbon-black, resin and solvent combinations where the carbon black is a small but critical constituent. With low concentrations of carbon black, high variations in resistivity result from small changes in composition.

The application of a protective coating is a critical step because of the large and general unpredictable increases in value produced. After considerable investigation, several types of sealant were found which give only moderate interference. As a typical example, screening a sealing coat of shellac on a sample of resistors containing 3 percent rejects broadened the distribution and shifted the values. As shown in Fig. 3, the shift was about 12

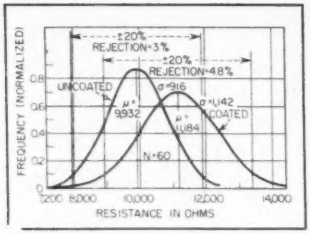


FIG. 3—Effect of overcoating on final resistance value

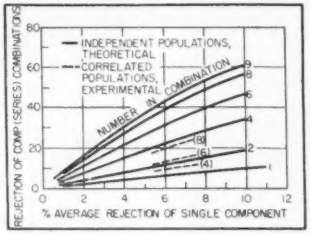


FIG. 4—How rejection rate increases with number of components

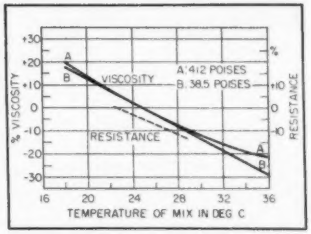


FIG. 5—Effect of temperature on viscosity of resistor mixes

percent and the rejection increased to 4.8 percent for this particular lot.

The rejection of component groups printed together, because of defects in one individual, has a significant bearing on all printed circuit applications. If the simplest series case is analyzed, the theoretical effect of combination, up to 9, is shown by the solid lines of Fig. 4. The rejections shown for combinations are based on the following assumptions: the complete assembly does not function when one member is out of specification, and the components in the group are from independent random populations which were not related during fabrication. This represents the maximum rejection, seldom met in production. Actually, in a process under control, there is considerable probability that an assembly rejected for one bad component will also contain another defective. For two or more resistors silk-screened simultaneously the correlation is sufficiently high so that rejects in aggregate amount to less than 40 percent of the above predicted value. These experimentally derived results are shown as the dotted lines in Fig. 4.

Process Variables

The major influences on the final value of resistors were found in the carbon concentration, screen opening size, curing temperature, overcoating formulation and the screening temperature. This is only a small proportion of the total number of variables.

Some indication of the factors entering into the printing operation can be had by applying the laws of fluid mechanics to the dispensing of wet resistor mix. The volume of a fluid discharged through a square orifice per unit time is described by the relation

$$q = \frac{\pi S^4 C}{7.12\eta} \frac{dp}{dL} \qquad (1)$$

If this is applied as an approximation of the flow of resistor mix through a screen opening, with consideration of the angle and pressure of the squeegee, the total volume discharged is

$$q' = \frac{\pi S^4 C T p}{7.12\eta L} \cos\theta \qquad (2)$$

Relating time to squeegee travel and velocity, combining constants and multiplying for additional orifices results in

$$Q = \frac{C_1 S^3 K A p}{\eta v L} \cos\theta \qquad (3)$$

The resistance of a particular uncoated resistor may be expressed in terms of its dimensions when dry (l, w, t_d) and specific resistance ρ

$$R = \rho \frac{l}{w t_d} \qquad (4)$$

Another consideration is volume change upon drying, in terms of the dimensions of the freshly screened resistor and a wet-to-dry ratio γ,

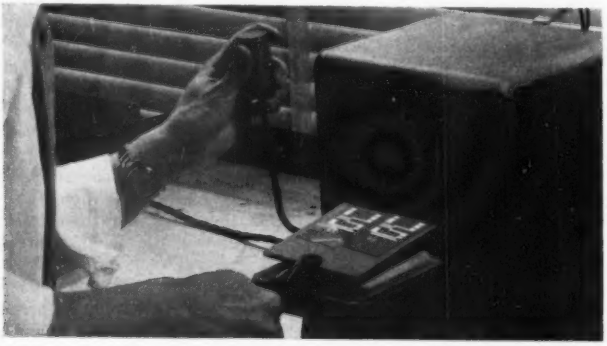
$$R = \rho \frac{l}{w \gamma t_w} \qquad (5)$$

As an approximation, the wet thickness t_w may be taken as equal to the volume of mix discharged (Q) divided by the cross-section or open area A in screen and pattern. Substituting this for t_w,

$$R = \frac{\rho \eta_1 L v}{K w \gamma S^3 \cos\theta p} \qquad (6)$$

in which

A = area in sq cm
R = resistance in ohms
μ = viscosity in poises
v = velocity of the squeegee in cm per sec
w = width of resistor in cm
l = length of resistor in cm
c_1 = proportionality constant
γ = ratio of wet to dry film thickness
S = linear parameter of sieve opening in cm
K = numbers of openings per sq cm of screen
L = distance fluid travels through screen in cm
ρ = resistivity in ohm-cm
θ = angle of the squeegee with respect to the work
p = vertical pressure of squeegee on the screen in dynes per sq cm
dp/dL = differential pressure throughout the length of an orifice



Placing coated glass plates in small furnace for curing of silver. Resistor printing with silk screen is next operation

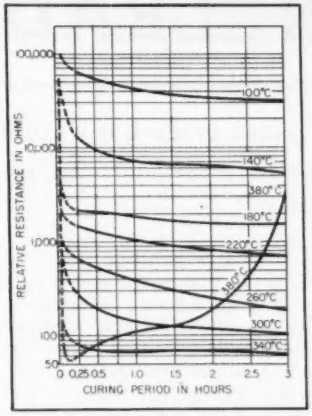


FIG. 6—Curing curves for mixture of lampblack and alkyd resin

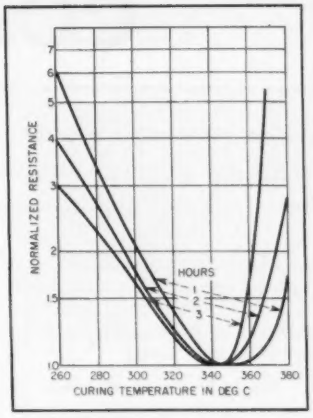


FIG. 7—Determination of optimum curing schedule for uncoated resistors

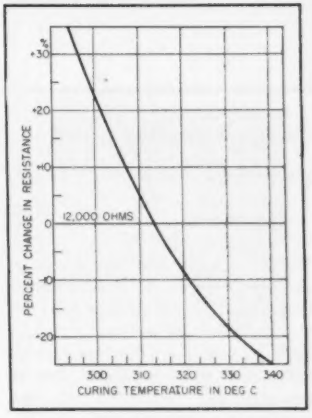


FIG. 8—Effect of curing temperature on uncoated resistors

C = nozzle coefficient
T = time of fluid flow in seconds

The value of a given resistance is thus illustrated to be effected by eleven factors in the screening process plus the superimposed effects of time-temperature in the curing cycle, interference during overcoating and the basic formulation of the mix. Equation 6 indicates that the resistance produced is directly dependent on the resistor length, viscosity of the mix, distance through the orifice and the speed of the squeegee. The resistance is inversely proportional to resistor width, the wet-to-dry ratio, holes per unit area, the pressure drop through the orifice, the squeegee angle and to the fifth power of the hole parameter.

Critical Factors

The influence indicated for the hole size suggests that wear of the screen may be a prime importance. The weight of some of the factors in Eq. 6 has been evaluated experimentally. A velocity increase of 14.4 percent in squeegee motion was found to result in an increase of 21 percent in uncoated resistor value. A decrease of 13.7 percent in viscosity resulted in a 12.6-percent decrease in resistance. The viscosity is markedly reduced by slight increases in the temperature of the mix at the time of screening. These three related variables are shown together on Fig. 5. Significantly, a rise of one degree centrigrade in room (mix) temperature during screening translates into a 2½-percent decrease in the mean value of resistors produced.

In the overall manufacture, the main curing step prior to coating is critical. Batches subjected to progressively higher baking temperatures decrease in resistance during curing as shown in Fig. 6, successively approaching lower and presumably more stable final values until the decomposition level is reached, when the resistance rapidly rises during baking.

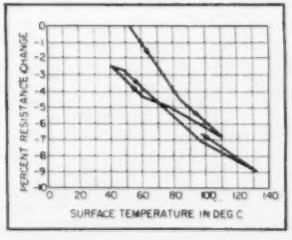


FIG. 9—Drift of protected 10,000-ohm resistor under temperature cycling

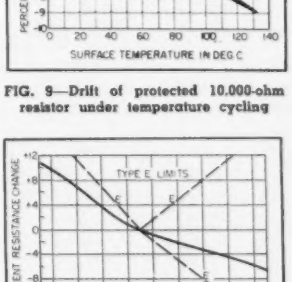


FIG. 10—Temperature coefficient for nominal 10,000-ohm silk-screened resistor

Similar data near the crossover point may be analyzed in a different manner, as in Fig. 7, to find the temperature-time schedule which represents the fastest approach to a low, stable value. With a curing schedule near the indicated optimum, resistors may be lowered 5 percent in value by an increase of only 3½ deg C, as shown in Fig. 8.

The use of a curing schedule optimized only with respect to speed and stability may result in higher noise levels; resistors processed by the fastest cure on Fig. 7 show about 3 microvolts per volt.

Screened resistors approximating the other JAN standards may be produced by the procedure outlined: an average voltage coefficient of about 0.04 percent per volt (25 C) has been noted. Drift is of about 3½ percent as shown in Fig. 9. The temperature coefficient, which is well within type E limits, is shown in Fig. 10.

In conclusion, the principle limitations in reproducibility are set by a critical carbon concentration, squeegee speed, a viscosity of screening which is sensitive to temperature, the curing temperature and the overcoating formulation. Theoretical analysis points also to squeegee pressure and to irregularities in screen openings as possible causes of large variations in printing.

CONELRAD

Crystal-controlled broadcast receiver gives alarm when key station to which it is tuned goes off air in response to FCC technique denying navigation aid to enemy aircraft. Malfunction in receiver itself sounds alarm

IN COMPLYING with the request of the Federal Communications Commission to participate in the air-raid warning project CONELRAD (control of electromagnetic radiation)[1] many broadcast station engineers are confronted with the problem of constructing monitoring equipment that will give an indication of carrier failure of a key station.

The simplest solution to the problem is to utilize the failure of the avc voltage of an existing receiver to trigger some warning device. This approach has several disadvantages. Most broadcast receivers are not designed for rack mounting, and therefore present a mounting problem if a neat and compact installation is to be maintained. Such receivers are often not constructed according to broadcast equipment standards, and they may leave something to be desired in the way of dependability when operated continuously.

Single-Frequency Receiver

It is possible to purchase a communications receiver that overcomes all these objections. However, this solution raises the objection of high cost plus the rather ridiculous situation of having provided equipment capable of tuning a large portion of the spectrum to monitor one frequency. The problem is simplified by starting from scratch and building a receiver solely for an alerting device.

Since the receiver is to monitor only one frequency, crystal control can be used and all front-panel tuning controls dispensed with. In addition, this design goes a long way toward achieving dependability by virtually eliminating oscillator drift problems. With such stability in the local oscillator, and since high-fidelity audio is not required, use of a rather low intermediate frequency is justified. This low i-f will permit great gain and selectivity in a minimum number of stages.

Low intermediate frequencies are usually accompanied by image interference, but for single-frequency reception it is easy to select the intermediate frequency and local oscillator frequency so that no strong images will be present. Design is further simplified in that the range of signal intensities encountered will be much less than that an ordi-

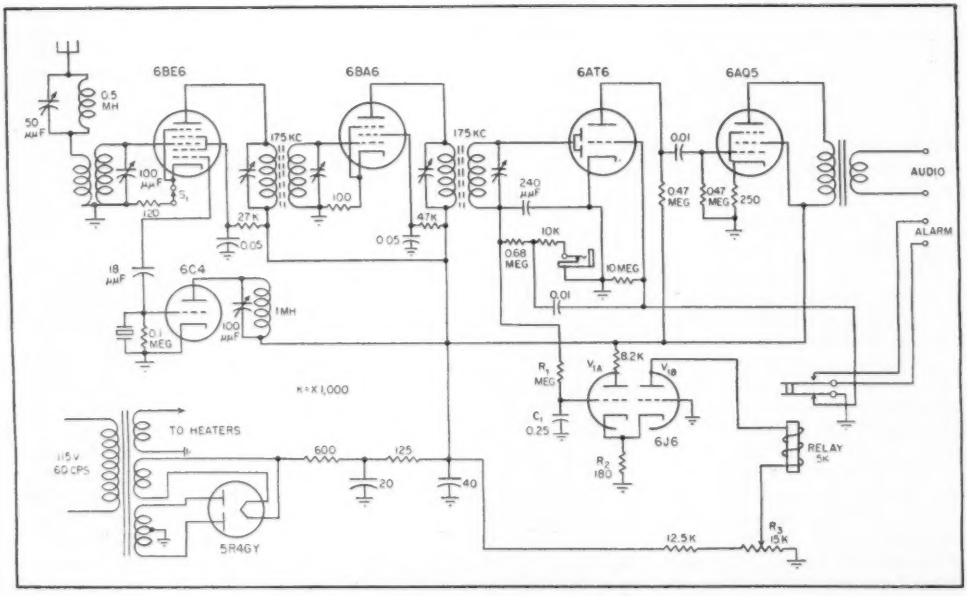
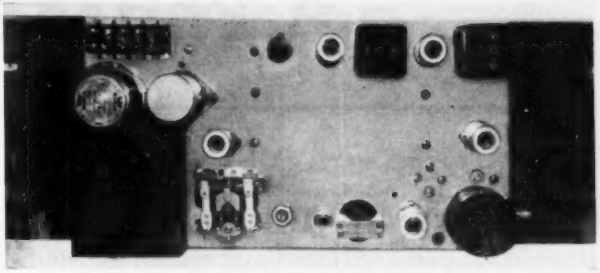


FIG. 1—Circuit diagram of the fixed-tune alert receiver

Alert Receiver

By MARTIN M. MITCHUM
Radio Engineering Consultant
Rolla, Missouri



Rack mounted receiver requires no front-panel controls

nary receiver is designed to accommodate.

The system to be described was constructed for use at radio station KTTR in Rolla, Missouri to provide day and night monitoring of KMOX in St. Louis, Missouri, which operates on 1,120 kc with 50-kw. During the day, a signal of the order of 0.5 millivolt per meter can be expected from KMOX. At night the signal will vary considerably above and below this value.

Image Signals

With this much signal, it was decided that a converter and one stage of intermediate-frequency amplification would be sufficient. Since image interference was no problem, it was decided to dispense with any stages of radio-frequency amplification preceeding the converter.

An intermediate frequency of 175 kc was decided upon and the local oscillator operates at a frequency 175 kc lower than the carrier frequency of KMOX or 945 kc. There is virtually no signal present in this area on the image frequency of 770 kc.

Reference to Fig. 1 will disclose few departures, other than those already mentioned, from normal receiver design. It was decided, in the interest of simplicity, to use no avc in this receiver. Since the signal strength is not great enough to overdrive the i-f stage, and since carrier fading is taken care of in the alerting device, avc would serve no useful purpose here.

A meter jack is placed in series with the second-detector load resistor to permit the use of a microammeter as an indicating device when it is desired to make tuning adjustments or to observe carrier fading.

The simplest and therefore most obvious method of obtaining an alert alarm would be to use the voltage produced by carrier rectification to bias a tube to cutoff. The condition could be indicated by inserting a relay in the plate circuit of the tube. A moment's reflection, however, shows that with this system many receiver failures (for example, heater failure of the control tube) could occur that would make the system inoperative and yet would give no indication that things were not as they should be.

Receiver Failure

It is desirable, therefore, to design an alerting device that will indicate receiver failure as well as carrier failure of the key station. The rectified carrier voltage is therefore used to bias a triode but the relay is inserted in the plate circuit of a second triode and the two triodes share a common cathode resistor.

Under normal operation, V_{1A} is biased by the rectified carrier voltage and R_3 is adjusted so that V_{1B} is conducting enough to hold the relay closed. If a carrier failure occurs, V_{1A} will conduct, producing an increased voltage across R_2. This increased voltage biases V_{1B} enough to cause the relay to drop out. Any receiver failure that causes V_{1B} to stop conducting (such as a failure of the rectifier tube) will give an alert.

An added set of contacts on the relay provides for closing a circuit to ring a bell in case the failure is of such a nature as to provide no audio voltage to operate the speaker. The components R_1 and C_1 have a time constant that prevents relay operation until two seconds after a carrier failure. This is to prevent operation of the alerting system by momentary fading of the night-time signal of KMOX. The relay is so adjusted that it does not reclose when the carrier of the key station is restored. Resetting is done manually. Snap-action switch S_1 provides simulated carrier failure for testing.

When the receiver was installed at the KTTR transmitter, some cross modulation was encountered. This was eliminated by inserting a wave trap tuned to the KTTR frequency in the antenna lead to the receiver.

Installation

The receiver was constructed for rack mounting and occupies 7 in. of panel space. The chassis mounts vertically and all wiring is exposed by removing the front panel but without removing the receiver from the rack cabinet.

No particular claim is made for the virtues of the components used in this receiver. Some of them were selected because they were on hand or readily available. In the case of tubes, selection was made, in part, on the basis of tubes already stocked by the station for replacement in other equipment.

REFERENCE

(1) A. A. McKenzie, War-Emergency Operation of Broadcast Stations, ELECTRONICS, p 94, Aug. 1951.

A Phase Indicator

High-speed device is useful in development of circuits for color tv and as an aid in aligning and producing color receivers. Other applications are p-m and f-m monitoring, direction finding and delay network problems

By KURT SCHLESINGER and LEROY W. NERO

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Motorola, Inc.
Chicago, Ill.

IN THE NTSC system of band-shared color television, the chromaticity information is transmitted by a subcarrier of 3.89 mc, whose amplitude and phase are used to transmit saturation and hue of the colors, respectively.[1, 2]

The need for an all-electronic high-speed phase indicator, capable of displaying on the screen of an oscilloscope, the instantaneous phase and amplitude of the color subcarrier became apparent. Such an instrument is described here.

Theory of Operation

The instrument requires two signal inputs: a constant carrier e_g at $\omega/2\pi = 3.89$ mc for phase reference and a test carrier at the same frequency but with unknown phase. As Fig. 1 shows, the reference carrier is applied to a balanced modulator, where it is split into two sidebands and suppressed. Since the local oscillator has a frequency $\Omega/2\pi = 1$ mc, the two sidebands are placed at nominally, 3 mc and 5 mc. The two carriers at 1 and 4 mc are suppressed in the special modulator, Fig. 2.

If both sidebands have equal amplitudes, the modulator output reads

$$e_1 = e_0 \tfrac{1}{2} [\cos(\omega + \Omega)t + \cos(\omega - \Omega)t] = e_0 \cos \omega t \cos \Omega t \quad (1)$$

This sideband doublet is employed to decode both the test signal

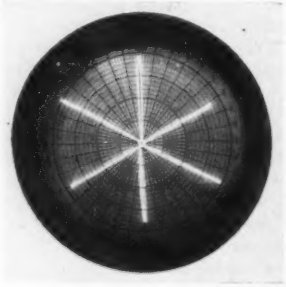
$$e_2 = A \cos(\omega t + \varphi) \quad (2)$$

and its quadrature component

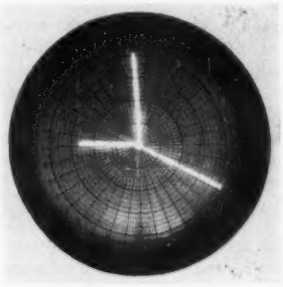
$$e_3 = A \sin(\omega t + \varphi) \quad (3)$$

To obtain the quadrature signal e_3 from the test signal, the latter is fed through a quarter-wave delay line or through a 90-deg phase shifter.

Both the test signal e_2 and the quadrature signal e_3 are then fed into separate synchronous detectors where they mix with the decoding wave e_1. Only demodulation products at the frequency $\Omega/2\pi = 1$



Hexagon display resulting from tying the instrument sequentially to six equidistant points along a delay line one wavelength long at 3.89 mc. Line was made up of lumped constants and contact to the instrument was made through an electronic sequencer



Odd-field display used to monitor an NTSC color test picture consisting of three horizontal bars per field, each in a saturated primary color. Short blue signal vector may be distinguished from a parallel but longer vector representing the cpa axis

for Color Television

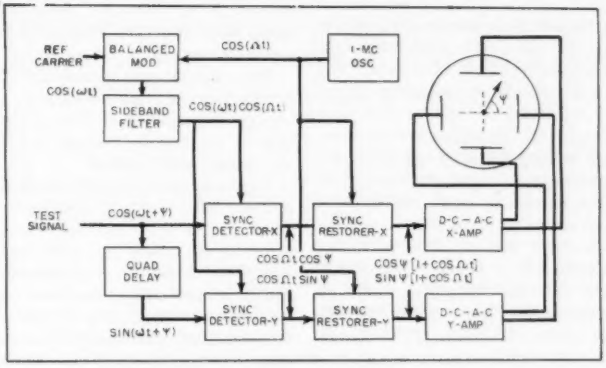


FIG. 1—Block diagram of the instrument called the Vectorscope

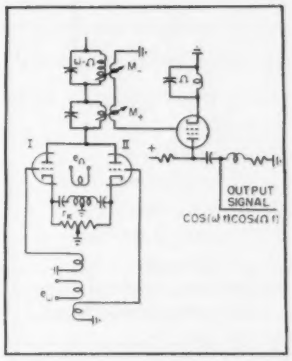


FIG. 2—Carrier-split circuit

mc are allowed to pass through the output filters of these detectors.

To find these components, expand Eq. 2

$$e_2 = A\ (\cos \omega t \cos \varphi - \sin \omega t \sin \varphi) \quad (4)$$

Since synchronous detection by e_1 yields no output from the sine term of Eq. 4, the detector output is

$$e_4 = \tfrac{1}{2}\, e_0\, A \cos \varphi \cos \Omega t \quad (5)$$

Similarly, the result of synchronous detection of e_2 by e_1 becomes

$$e_5 = \tfrac{1}{2}\, e_0\, A \sin \varphi \cos \Omega t \quad (7)$$

If the phase signals e_4 and e_5 were used directly for deflection in the x and y direction, respectively, the result would be a phasor with the correct amplitude and inclination, swept through the center of the screen by a one-mc sine wave. This type of display is unable to differentiate between phasors 180-deg apart.

To avoid this ambiguity, a radial offset is desirable, which makes each phasor start from the center on outward. Mathematically speaking, this requires the addition to the phase signals e_4 and e_5 of shift voltages of the form

$$e_6 = \tfrac{1}{2}\, A\, e_0 \cos \varphi \quad (7)$$

$$e_7 = \tfrac{1}{2}\, A\, e_0 \sin \varphi \quad (8)$$

respectively. In operation, these terms can assume either polarity.

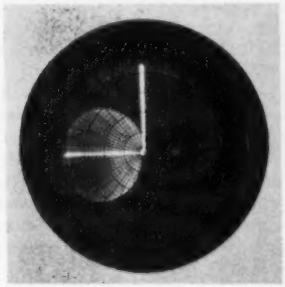
Synchronous Restorers

Generation of the shift-signals e_6, e_7 from the phase signal input e_4, e_5 is done in two synchronous d-c restorers. At the restorer output, shift and phase signals are combined

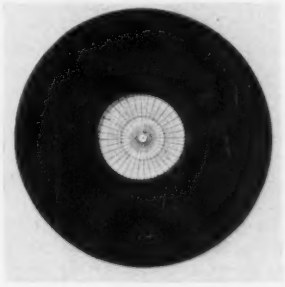
$$e_y = \tfrac{1}{2}\, e_0\, A \sin \varphi\, [1 + \cos (\Omega t)] \quad (9)$$

$$e_x = \tfrac{1}{2}\, e_0\, A \cos \varphi\, [1 + \cos (\Omega t)] \quad (10)$$

These composite voltages require only some suitable amplification, see Fig. 5, before being applied to the deflecting plates of the instrument. The resulting vector display con-



Attempts to lock a quartz crystal in with a variable frequency. Two vectors at 0 and 90 deg show resulting quadrature relationship between input and output. Vector pattern is response of the quartz. Luminescent area displays the expected circle diagram



Appearance of side-locking, the locking of a resonator on sidebands of a carrier which arrives in bursts. This vector display of first-order side-locking shows a luminous circle swept by a radius vector rotating at a speed of 15,750 revolutions per second

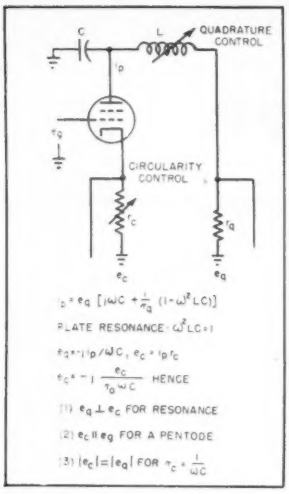

C
L
QUADRATURE CONTROL
CIRCULARITY CONTROL
e_c
e_q
$i_p = e_q\,[j\omega C + \frac{1}{r_q}(1-\omega^2 LC)]$
PLATE RESONANCE: $\omega^2 LC = 1$
$e_{g1} = i_p/\omega C$, $e_c = i_p r_c$
$\frac{e_c}{e_{g1}} = \frac{r_c}{r_p \omega C}$ HENCE
(1) $e_q \perp e_c$ FOR RESONANCE
(2) $e_c \parallel e_q$ FOR A PENTODE
(3) $|e_c| = |e_q|$ FOR $r_c = \frac{1}{\omega C}$

FIG. 3—Pentode delay circuit

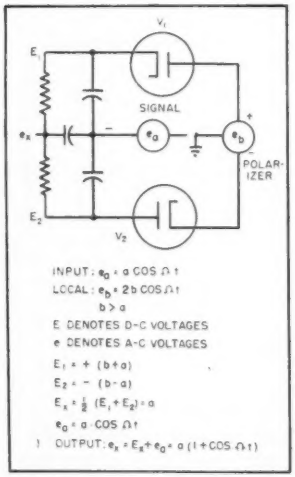


FIG. 4—Synchronous d-c restoration

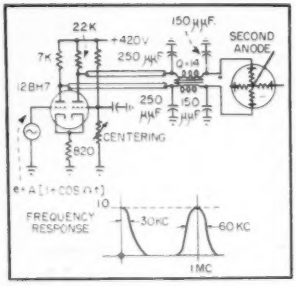


FIG. 5—Deflection amplifier for instrument display

veys not only the angular or phase information, but amplitude information as well, as long as the reference level e_0 is kept constant. The instrument is thus capable of a complete vector presentation of the test carrier in polar coordinates.

Unconventional Circuitry

Figure 2 presents the carrier split circuit used to replace the 4-mc reference by two sidebands at 3 and 4 mc. This unit employs a double triode modulator with double balance; both the signal carrier ω as well as a modulating carrier Ω are applied in push-pull fashion. The plate output is single ended with both plates in parallel.

If the triodes are balanced at the cathode bias resistor r_k as shown, both carrier frequencies ω and Ω cancel in the plate circuit, whereas the two sideband energies at $(\omega \pm \Omega)$ add.

The sideband frequencies are selected by two circuits tuned to 3 and 5 mc, respectively. By adding controlled amounts of pickup from each in a common tertiary, the sideband amplitudes are equalized and the desired decoding signal e_1 results. The output amplifier is flat beyond 5 mc and has a tuned cathode trap to remove any remnants of the 1-mc carrier.

The signal delay circuit used to obtain e_3 from e_0 is shown in Fig. 3. The circuit permits separate adjustment of amplitude ratio and phase angle between two output voltages e_g and e_c. This is shown by the set of equations indicated on Fig. 3 that quadrature between e_g and e_c is obtained for any value of r_g by tuning the plate inductance for resonance. Circularity or equal output in both phases results if the cathode resistor r_c equals the reactance of the plate capacitor C. The values of plate inductance and plate load resistance r_g are again immaterial in this respect.

The transfer constant of this circuit is somewhat less than unity. The use of a pentode, rather than a triode, insures phase coincidence between grid voltage and cathode output regardless of the plate load impedance.

Figure 4 demonstrates the principle of synchronous d-c restoration which is used in the instrument to add a radial shift to an on-center display of phasors. The technical problem consists in converting a waveform $A \cos\Omega t$ into the composite wave $A\ (1 + \cos \Omega\, t)$, where A can assume both positive and negative values in rapid succession. To make the restorer polarity conscious, a synchronous polarizing wave is used whose amplitude exceeds the signal.

Two diodes serve as envelope detectors for sum and difference of signal and polarizer. The difference of the two d-c outputs is then the desired shift voltage.

Figure 5 shows the deflection output amplifier used in the instrument. Since the signal consists of a constant frequency component and a d-c shift, the frequency response of the unit is designed for two separate lobes. One is around 1 mc and the other around the d-c axis. The bandwidth of each lobe is chosen such that the resulting speed of a-c and d-c response is of the same order, 5 μsec. This prevents the vectors from overshooting the center for rapidly varying color signals.

Color Applications

The photographs illustrate some of the results obtained when the device was put to use in connection with color equipment. The instrument was first lined up by tying it sequentially to six equidistant points along a delay line one wavelength long at 3.89 mc. The line was made up of lumped constants and contact to the instrument was made through an electronic sequencer, with each contact lasting 1/360 sec.

The use of a phase indicator of this type is not limited to color television. Other applications include p-m and f-m monitoring, direction finding and problems involving delay networks. This includes the study of phase and delay distortion in the general four-terminal network.

References

(1) C. T. Hirsch, W. F. Bailey and B. D. Loughlin, Principles of NTSC Compatible Color Television, Electronics, p 88, Feb. 1952.
(2) Specifications for Color Television Field Tests, Electronics, p 126, Jan. 1952.

Power Control With Magnetic Amplifiers

Recent developments in high-power industrial magnetic amplifiers, which have been overshadowed in the past few years by more glamorous advances in miniaturization, are described. New materials and circuits improve power control characteristics

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THREE outstanding advances have changed the magnetic amplifier from the crude and sluggish amplifier of 20 years ago to the amazingly fast, flexible, and powerful control component of today. These are: the self-saturating circuits, which raised the ratio of power gain to response time by about 100; the development of square-loop magnetic materials such as Hipernik V and others which gave combined high gain with high output, and improved control; and improvements in dry-type rectifiers which further improved the gain, stability, and reliability.

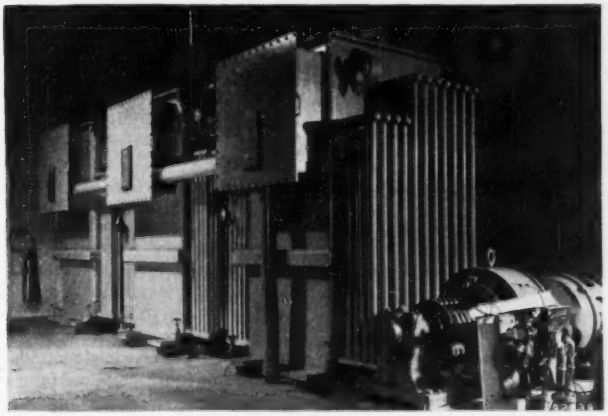
This article is based on a paper presented at the American Power Conference, sponsored by Illinois Institute of Technology.

Operation of the self-saturated magnetic amplifier may be explained by the idealized half-wave circuit of Fig. 1A in which a large inductance blocks a-c from the control winding. During the reverse (opposite to rectifier) half cycle of voltage the flux density B has assumed a value corresponding to the control current, I_{cc} as shown in Fig. 1B. When the forward half cycle of voltage occurs, the core generates a back voltage preventing the flow of load current until the core saturates. This is repeated each cycle.

The average voltage reduction on the load, occasioned by this delay in firing (Fig. 1C) on each forward half cycle, is directly proportional to the flux reduction, $\Delta\phi$, below saturation produced by the control current I_{cc}. The control characteristic of Fig. 1D results. Practical full wave circuits operate in essentially the same manner but do not require the inductor in the control circuit.

The basic magnetic amplifier circuits now in use for power control represent many combinations and modifications of the circuit shown in Fig. 1. The self-saturated types have replaced the simple saturable reactor type for most applications. Most popular are the parallel-connected or doubler circuit, with a-c output; the center-tapped transformer, full-wave connection for d-c output; and the bridge connection for d-c output. The doubler output can of course be rectified for d-c output. Usually the choice of d-c or a-c output and the voltage rating will determine which circuit should be used.

The rectifiers may be divided into self-saturating, those directly in series with saturable reactor windings, and simple rectifying units. The latter act as in any rectifiers but the former have the added requirement of low and stable back current to produce high amplifier gain and low drift. In low-voltage applications, where a single disk in series is adequate, the bridge connection results in smaller size and weight, whereas if several disks are required in series, the doubler (requiring fewer self-saturating rectifiers) is advantageous. Such and



Magnetic amplifiers for controlling 1,800-kw 60-cps power supply for r-f heater on tin reflow line. Motor-generator set supplies d-c control power

other practical considerations dictate the basic circuit to be employed.

The center-tapped transformer connection and the bridge connection correspond to the connections of dry-type rectifiers except for the insertion of the saturable reactors to control the firing, giving the equivalent of a thyratron grid delay. This equivalence gives rise to the symbolic representation used in the remainder of this article, in which the rectifiers alone are shown with the control and bias windings indicated schematically.

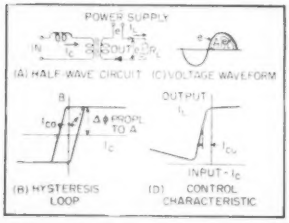


FIG. 1—Idealized magnetic amplifier circuit and characteristics

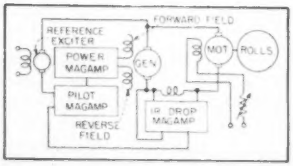
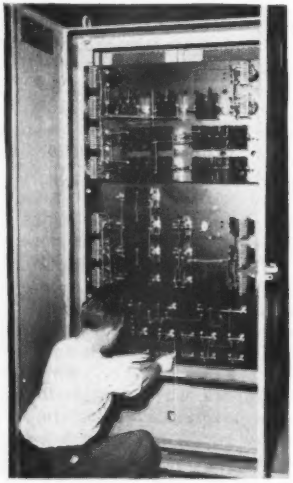


FIG. 2—Schematic of magnetic amplifier for one stand of tandem steel mill regulator



Cubicle housing 400-cps pilot, power and IR-drop magnetic amplifiers for tandem steel mill regulator (Fig. 2)

A few typical power applications illustrate the potentialities of this new tool.

Steel Mill Regulator

The four or five stands of a tandem cold rolling mill are regulated to follow in speed a master d-c reference bus which brings the mill from a low threading speed up to running speeds of over a mile a minute in a matter of six seconds, closely controlling the tension all the while. The stop is also six seconds (four in emergencies) and uniform tension between stands must be maintained down to standstill.

A high grade regulator is required which can maintain proper interstand relations throughout this difficult cycle in spite of minor load fluctuations and irregularities. High regulator speed prevents differing acceleration lags and prevents loops accumulating due to minor fluctuations of material or voltage. Reliability is a prime requisite because a shutdown means serious loss of production.

Figure 2 shows the circuit of a magnetic amplifier regulator for one stand of such a mill. The equipment replaces an earlier system with about 5 to 1 improvement in response time, greatly simplified damping requirements, simpler adjustments and consequent improved reliability. The inherent delay in a magnetic amplifier tends to be about the same number of cycles, irrespective of frequency so that the 420-cycle magnetic amplifier is inherently seven times faster than a corresponding 60-cycle unit.

Other Mill Applications

Magnetic amplifier applications have also been made to the main drives of many other types of mill, tin plating lines, and printing presses, as well as to many auxiliaries.

The reel drive is worthy of special notice since so much processed material must be reeled and rereeled as it passes through various processes from the raw material to the finished product. The usual requirement is a constant tension drive permitting a reduction in rotational speed as the material builds up on the reel. This is secured by current regulation, the magnetic amplifier comparing the reel motor current with a reference and controlling the motor field current accordingly. Highly successful applications have been made and it is interesting to note that the control panel, including the magnetic amplifiers, for one of these is no larger than the control panel previously used for the rotating regulators being displaced.

Magnetic amplifiers are now controlling the firing circuits of ignitron rectifiers, providing a smooth reliable control and replacing the thyratrons previously used for this purpose.

Regulated d-c power supplies are now available, entirely without vacuum tubes. These are being applied in government applications at present but will also provide an almost maintenance-free unit for industry.

Magnetic amplifiers have been used for years in certain variable speed controls to cranes and hoists. Now the new high performance units are bringing in a whole field of applications of variable speed drives, both d-c and a-c, for all kinds of industrial operations, elevators, wind tunnels, and the like.

Tin Reflow Line

High performance control is nowhere better exemplified than in the tin reflow line where high-frequency heat raises the temperature of electrolytically-plated tin to the flow point so precisely that with the plated strip moving nearly half a mile a minute, the flow line remains stationary in position. A phototube signals the position of the flow line to an amplifier. Power is amplified through an exciter and three 600-kw power magnetic amplifiers to the plates of the tubes that generate the high frequency for heating. This set-up is shown in Fig. 3.

The smooth control obtained with static high power equipment is advantageous in this case. Of interest is the use of electronic, rotating, and magnetic amplifiers, in this single control. However, the present

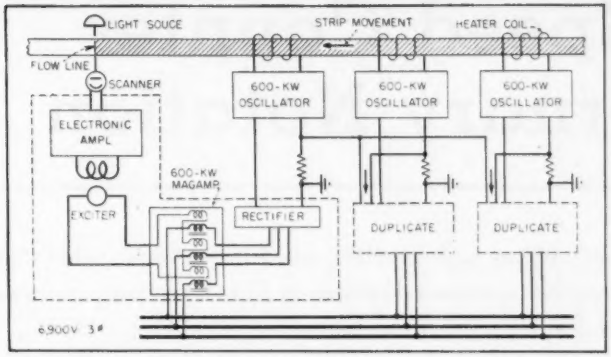


FIG. 3—Tin reflow line requires a series of 600-kw magnetic amplifiers for accurate heating control

trend is to extend the use of the magnetic amplifier.

Magnetic amplifiers are finding use in generator excitation systems from the smallest aircraft generators to the largest central station unit. The advantages offered are numerous.

Exciter Circuit

A magnetic amplifier excitation unit and regulator for machines of several hundred kilowatts is shown in Fig. 4. In this case about half of the excitation at full load is supplied directly by series compensation, resulting in extremely rapid response to sudden load changes. The balance of the excitation required for no load and to compensate for drift, aging, temperature changes and forcing is supplied through the exciter under control of the static regulating circuit.

The latter unit in effect compares the generator voltage, compensated for reactive drop, with a fixed reference and provides a corrective signal to the magnetic amplifier in event of any voltage deviation from setting. Essentially the same magnetic amplifier that serves as the exciter for this size generator would be the pilot magnetic amplifier supplying a main exciter for the largest turbine-generator units.

In addition to voltage, all manner of other quantities are being regulated. These include speed, frequency, position, temperature, charging rate, light intensity, and the like, it merely being required to reduce the regulated quantity to an electrical signal for application to the amplifier.

Military Applications

Greatest current interest in power magnetic amplifiers is in the military field, where because of their smaller size, greater efficiency,

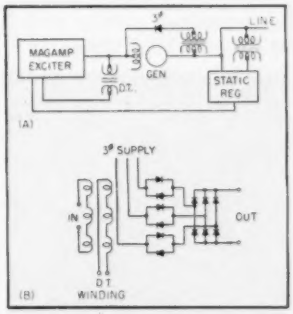


FIG. 4—Magnetic amplifier and regulator for machines of several hundred kilowatts

rugged construction and prospective freedom from maintenance, they are replacing electron tubes in many applications. A number of autopilots and gun mounts and stabilizers are already converted, a single autopilot using over 30 separate magnetic amplifiers. The tremendous development in the military field is making technical improvements in power magnetic amplifiers available at a rapid rate for industrial applications.

D-C Transductor

The d-c current transformer like perpetual motion was long ago crossed off the slate as impossible. However, the series-connected magnetic amplifier has an equal-ampere-turn law and provides isolation of instrumentation from d-c power circuits and so serves the role so well that it is by courtesy sometimes called a d-c current transformer. For larger direct currents of 2,000 to 75,000 amperes, the d-c is passed through the openings of the saturable reactor cores and acts as the control current. The a-c secondary current is proportional to it. For smaller currents, shunts are more economical and auxiliary current-transductors are used for the isolation function.

Similarly shunt-connected magnetic amplifiers are used to isolate the power d-c bus from potential coils of switchboard instruments. Other instrumentation uses of magnetic amplifiers are to thermocouple and photocell amplifiers, strain gages and as a d-c amplifier.

Performance

The figure of merit of small 10 to 50-watt magnetic amplifiers is of the order of 1,000 per cycle, this figure increasing with physical size. This means that a power gain of 10,000 per stage is feasible with 10-cycle time constant or 3,000 with 3-cycle time constant, and so forth. Special circuits have been developed to carry this relation down to one cycle or less.

The control characteristic of the magnetic amplifier approaches a straight line relationship between control current and output or load current.

For many industrial controls the advantage of using available 60-cycle power sources precludes 400 or 800-cycle sources for the improved speed and lower weight. Static frequency multipliers are available and afford an answer to this problem for the lower power stages.

A frequency tripler, three phase from single phase, is composed of a star-delta transformer bank operated in saturation with the triple frequency load taken from one corner of the delta.

The applications which have been cited are typical of literally hundreds of applications being made in all branches of power control.

High-Speed Counter Uses Ternary Notation

Counter based on powers of three attains high counting speeds using fewer tubes than conventional counters. Circuit described operates reliably up to 175,000 counts per second using only nine stages. Application of circuit in fast nuclear scalers is predicted

MOST ELECTRONIC COUNTERS are binary in nature. Regardless of the number system used, they are made up of binary cells. In such counters, those using binary notation are most economical, not only in cost, but also in space and power requirements for a given memory capacity.

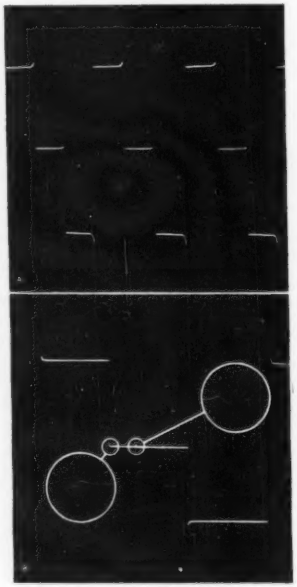
The usual four-tube decade when employed in a scale of one thousand would have a scale of over four thousand if the same twelve stages were used in binary notation. In commercial applications, such as nuclear scalers, even with binary notation there is a severe limitation in the memory capacity of a reasonably sized unit.

To take full advantage of a high-speed counter when storing large counts, it is necessary to use more binary stages than are commonly employed in nuclear scalers. Since the usual mechanical number register has a maximum speed of about twenty counts per second, to utilize the full speed of a 200-kc counter, at least fourteen binary stages must be used ahead of the number register. This is more than twice the number of stages found in commercial units. Improvement would be achieved through use of a memory element comparable in size and cost to the binary element but having greater memory capacity. The advantage of reliably increased memory capacity in large computers needs no explanation.

This paper describes a simple ternary memory and a fast counter using this memory in ternary notation. Any number of stages may be used, giving a number capacity of 3^n for n stages. In this counter, eight stages provide a scale of 6,561 as contrasted with 256 for an eight-stage binary counter.

Ternary Memory

The flip-flop circuit, which provides conventional binary memory, may be considered as a closed-loop positive-feedback circuit comprising two amplifier stages. When the loop gain is greater than one, the circuit is unstable, and any minute change in plate current of either tube will reinforce itself and keep building up until loop gain is reduced to one, either by an approach to saturation in one tube or an approach to cutoff in the other.



Ternary counter waveforms illustrate the three discrete operating states comprising a counting cycle. Stage 2 plate voltage (B) shows division by three of input pri. Stage 1 plate voltage is shown in (A)

The circuit will then be in a stable condition until a change in voltage in any part of the loop drives it back to the region of higher gain. The change will then continue until limited by saturation or cutoff of the opposite tube, affording a second condition of stable operation.

To obtain more than two stable states, there must be an intermediate region wherein loop gain is reduced below unity. This may be accomplished by insertion of additional nonlinear elements into the loop. A convenient way of inserting the required nonlinearity is the use of diode coupling between cathodes. The component requirement is about the same as that of a Higinbotham-type binary stage[1].

Theory

The ternary memory is illustrated in Fig. 1. With the diodes removed, each half of the circuit resembles a phase-splitting circuit wherein plate and cathode resistances are about equal. The gain of each half is approximately one at both plate and cathode. Plate currents of both halves will be equal, since the circuit is symmetrical. Total loop gain will be the product of the gains of each half (slightly less than one).

If the cathodes are tied together,

Much of the work described in this article was carried on at Illinois Institute of Technology.

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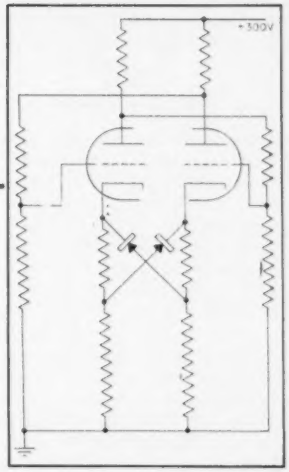


FIG. 1—Basic ternary memory has three stable operating states

in addition to the signal at the grid of either tube, we may consider that another signal is injected at its cathode by the cathode of the other tube. The loop gain will now be greater than one and the circuit operates as a flip-flop. Another way to visualize the effect of tying cathodes together is to consider that as long as the circuit is symmetrical, increase in plate current of one tube will be cancelled by decrease in plate current of the other tube and the cathodes will remain at a fixed potential, thereby eliminating the degenerative effect of the cathode resistor.

With diodes connected as shown in Fig. 1, as long as both plate currents are the same, the cathodes will be at the same potential and both diodes will be nonconducting since the diode anodes are at a negative potential with respect to their cathodes. A stable intermediate condition is thus provided as though the diodes were not in the circuit.

Memory Operation

If a pulse is applied at any electrode, the pulse being of sufficient amplitude to cause an amplifier cathode to move to a voltage below that of the tap on the opposite cathode resistor, or to raise a cathode resistor tap above the potential of the opposite cathode, a diode will begin to conduct. Once a diode begins conducting, the effect is the same as that of tying the cathodes together through a small resistor. Loop gain will be increased to a value considerably greater than one, and flip-flop action will take place. Any tendency of a diode to conduct will result in a signal injected at a cathode, the signal being of the right polarity to make the diode conduct still further. Thus, using nonlinear coupling in a closed-loop positive-feedback system, it is possible to obtain three regions in the conduction characteristic wherein loop gain is less than unity, and consequently to achieve three stable conditions. The three states are well defined and widely separated. Plate potentials in a typical circuit are 135, 190 and 255 volts.

Counting, or plus-one operation necessitates driving the memory successively through its three states by a repeated pulse at the same point of the circuit. If the counter is to be used in ternary notation, the operation must be cyclical. Instead of stopping at the last stable position, the circuit must revert to its initial condition on the next impulse and repeat its cycle.

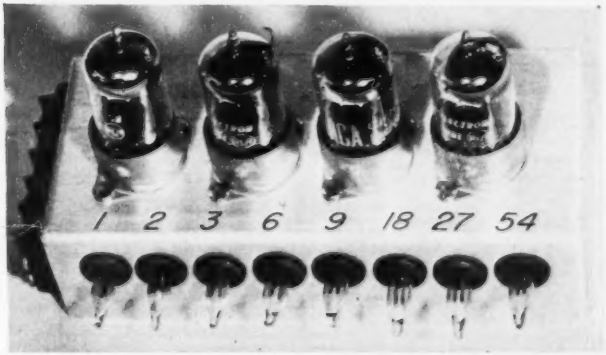
Counting Operation

Derivation of the cyclical counting operation from the ternary memory requires the use of the same plate-to-grid capacitors found in binary memories. Injection of the input pulse at a cathode is used here, but plate and grid injection have been found successful as well. An advantage of additional stability is obtained by cathode injection because of relative freedom from kickback from the driven stage since the injection point is not subject to full transition voltage.

Counting Circuit

Two stages, providing a scale of nine, and the means for interstage coupling are shown in Fig. 2. Additional stages of the same type may be added as desired. The explanation of the first stage applies also to subsequent stages.

Referring to the first stage, the three stable states are designated as follows: 0,V_{1B} cut off, 1,V_{1B} and V_{1A} both in medium conduction, and, 2,V_{1B} fully conducting. The sequence of states is 0-1-2-0. In state



Four-stage ternary counter, with two-light-per-stage indication, having a scale of 81. Lighted neon bulbs indicate 3" and 2 × 3"

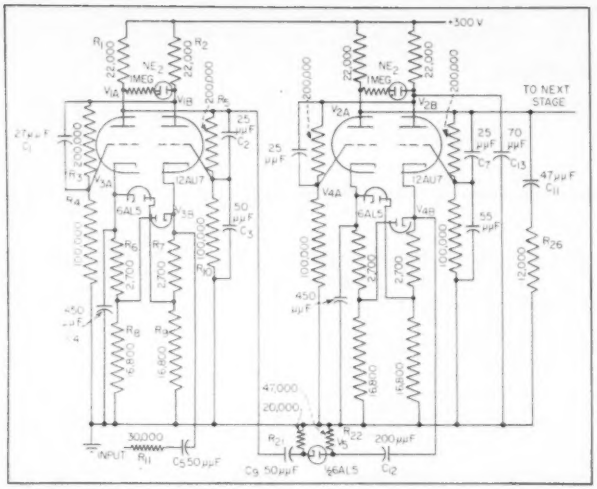


FIG. 2—Successive negative pulses to V_{1B} cathode drive the counter through its three states. With V_{1B} cut off, first pulse drives both tubes into conduction. Second pulse cuts off V_{1A}. Third pulse returns circuit to initial condition

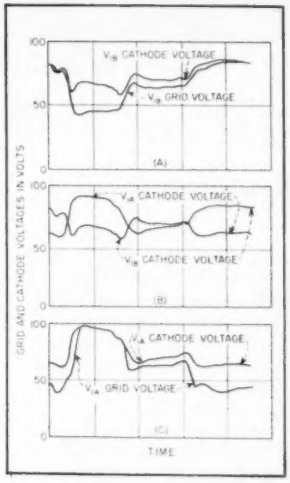


FIG. 3—Simultaneous grid and cathode voltage waveforms from both stages show step-by-step counter operation

0, V_{1B} is cut off and V_{1A} is fully conducting. A negative-going pulse of one microsecond duration is injected at the V_{1B} cathode. The momentary lowering of cathode potential drives V_{1B} out of cutoff and multivibrator action ensues, carrying the stage toward state 2. When both triodes are in the region of medium conduction, the cathodes are at the same potential and diodes V_{3A} and V_{3B} are nonconducting because of negative plate-to-cathode voltage. The input pulse has by this time disappeared. Multivibrator action ceases because cathode degeneration is permitted in the region of medium conduction and overall loop gain is reduced below unity. Thus the stage never reaches state 2 on the first pulse, but remains stably in the medium-conducting state.

Second Pulse

The next input pulse increases the conduction of V_{1B} to a point where loop action drives the cathode of V_{3A} negative with respect to its plate. Cathode degeneration is no longer permitted and multivibrator action takes place until state 2 is reached. Cutoff of V_{1A} reduces the loop gain and the circuit remains stably in state 2. V_{1B} is now fully conducting.

The next input pulse drives V_{1B} into positive-grid-voltage region wherein C_2 takes on an additional function. Because of diode action between grid and cathode of V_{1B} during the pulse, current flows through R_1 to increase the charge of C_2. When the input pulse has ended, V_{1B} grid is sufficiently negative with respect to its former potential for V_{1B} to start into cutoff. The new potential across C_2 is maintained for a long enough time for the stage to pass completely through stage 1 and directly to the stable 0 condition. Diode action between grid and cathode of V_{1B} acts as a pulse stretcher, permitting fast charge and slow discharge of C_2. Thus the secondary effect of the input pulse, which is to lower the grid potential of V_{1B}, is prolonged until some time after the pulse itself has ended. By virtue of this secondary effect V_{1B} begins to cut off.

Memory Reset

Multivibrator action takes the stage to state 1, but this time, instead of stopping in state 1, the stage passes through the middle state directly into the initial 0 condition since C_2 still retains some charge from the prolonged secondary effect. Since V_{1B} has previously been cut off and its grid is considerably lower in potential than its

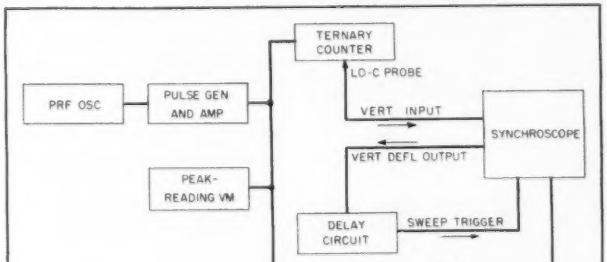


FIG. 4—Ternary counter and test equipment setup used to study circuit operations. Waveforms shown in Fig. 3 were traced from synchroscope

cathode, the secondary effect can not occur in the transition from state 0 to state 1.

Typical waveforms of the ternary counter are shown in the photograph. They were taken at the first and second stage plates. For a detailed study of the various events occurring simultaneously in different parts of the circuit during each transition, it was found convenient to make tracings directly from the oscilloscope. Intensity modulation was used to secure a fixed time reference so that waveforms taken from separate points could be shown accurately on the same time axis. Use of a variable sweep delay permits display of the three transitions in the first stage on a time base of one microsecond per centimeter. Figure 3 shows the essential voltage relationships in the grid and cathode circuits with blanking markers derived at the start of each input pulse. The test setup, which is useful in any general study of counters and similar circuits, is shown in the block diagram, Fig. 4.

Circuit Details

In Fig. 2, capacitor C_3, not only complements the secondary effect in the 2-0 transition by a fast discharge-slow charge action similar to that of C_2, but also serves to reduce overshoot from the 0-1 transition. This overshoot would result in V_{1B} grid being driven farther negative than its normal state 1 potential and would tend to produce an undesired 0-2 transition. Capacitor C_4 acts to reduce rise time of V_{1A} plate voltage. Relatively fast rise of V_{1A} plate voltage in the 2-0 transition is necessary to obtain a sufficiently sharp output pulse to drive the succeeding stage.

Resistor R_2 prevents overshoot in the input pulse, which would otherwise result from the C_5-R_7-R_8 combination when the input pulse is rectangular. With R_{11} in the input circuit, the input pulse shape is not critical. In the second and subsequent stages C_{12} is added; C_{12} permits use of the comparatively slow rising pulse derived from the previous stage by slowing up the 0-1 transition to assure the passing of the input pulse by the time transition is well under way. In the first stage, faster counting speed requires a shorter input pulse and C_{12} is not necessary.

To derive the pulse for triggering the second stage, the step waveform of the 0-2 transition in the first stage is differentiated by the R_{21}-C_9 combination. Diode V_5 eliminates positive pulses from 0-1 and 1-2 transitions. Resistor R_{22} establishes the diode plate reference point and C_{12} serves as a blocking capacitor. At the second stage output R_{20} and C_{11} are used as an output load to represent the succeeding stage.

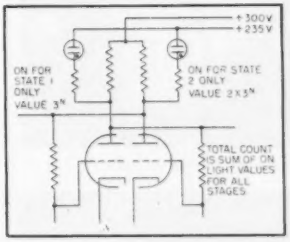

+300V
+235V
ON FOR STATE 1 ONLY VALUE 3^N
ON FOR STATE 2 ONLY VALUE 2×3^N
TOTAL COUNT IS SUM OF ON LIGHT VALUES FOR ALL STAGES

FIG. 5—Two-light-per-stage ternary indicating system

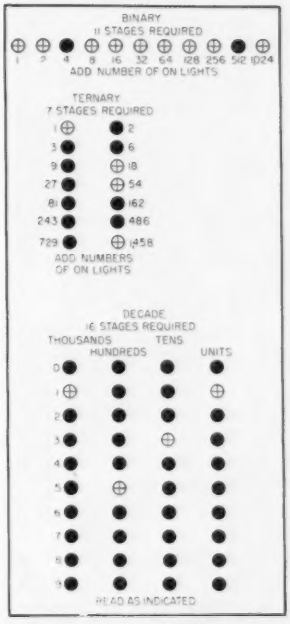


FIG. 6—Number 1,531 displayed in binary, ternary, and decade indications. Economy in number of stages characterizes ternary system

Diodes in this circuit are hard tube types, but germanium rectifiers will work equally well.

Indicating System

The indicating system shown in Fig. 2 requires only one neon light per stage. The left electrode glows in state 0, the lamp is dark in state 1, and the right-hand electrode glows to indicate state 2. In applications where ease of reading is more important than compactness, a two-light-per-stage system as shown in Fig. 5 may be used. In either case, there is no marginal operation and no resistor network is needed to obtain the read-out in ordinary ternary notation. As an example of the ternary read-out with two lights per stage compared with the conventional binary and decade indication the arbitrary number 1,531 is displayed in Fig. 6 in three different systems. The relative number of stages required is indicated for each system.

Components

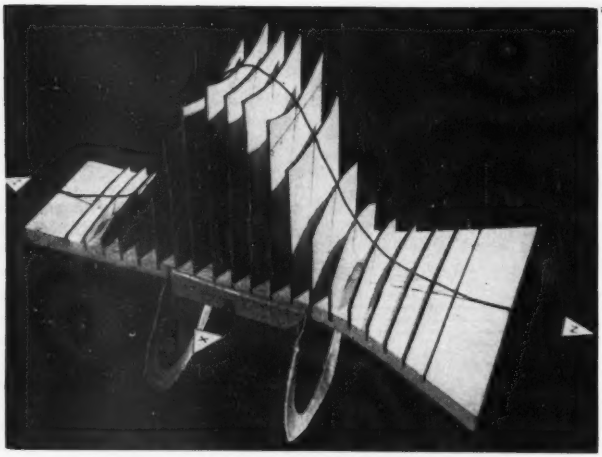
The counter operates reliably at speeds up to 175,000 pulses per second. Input pulse height can vary from 85 to over 150 volts with perfect counting action throughout the range. The component tolerances are about the same as for a conventional binary counter. Symmetrically located component pairs are required to be matched within five percent with the exception of the plate load resistors, which can be within twenty percent. If the required matching of pairs is effected, the pairs may be within ten percent of the nominal value. Exceptions may be made for R_{21}, R_{22}, R_{11}, C_5, C_6, C_4, C_{10} and C_{12}, which need only be held to within twenty percent of nominal value.

The counter is not critical of supply voltage variation and will operate satisfactorily with B voltages from 250 to 325. At the nominal operating voltage of 300 volts, the current drain is about eight milliamperes per stage, which is about the same as that of the conventional Higinbotham-type binary stage of equal speed.

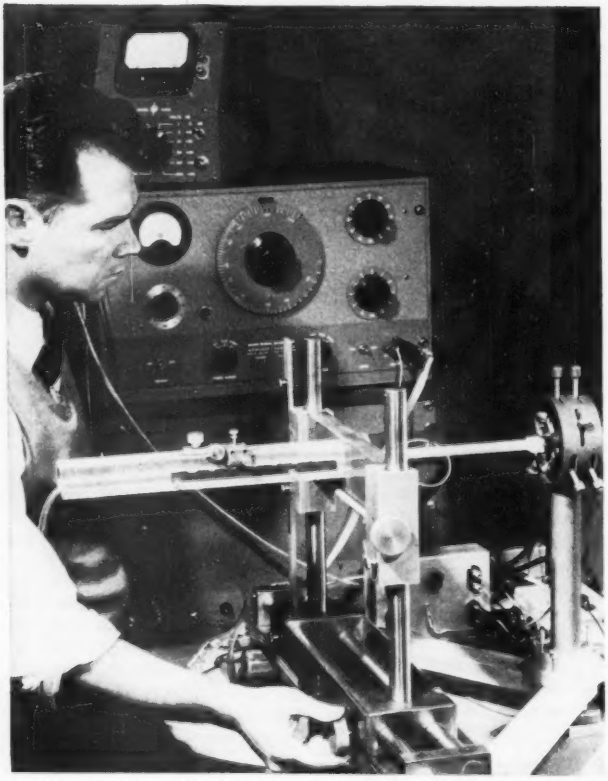
Reference

1. W. Higinbotham, J. Gallagher, M. Sands, The Model 200 Pulse Counter, *Rev Sci Instr*, **18**, 10, Oct. 1947.

Field Plotting in



Space-model plot of the H_y component through the xz plane



Field-plotting equipment. Probe coil may be rotated fully about the longitudinal axis of the probe rod

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SCANNING PROBLEMS in television picture tubes challenge the ingenuity of the television engineer. This is largely because of the difficulty of analyzing the magnetic deflection yoke, the heart of the scanning system in common use. Significantly, the conventional deflection yoke was developed almost entirely by empirical techniques.[1,2,3,4]

Competition has fostered a demand for better picture quality and picture tubes with larger faces and shorter neck and cone lengths, all of which magnify the difficulties of yoke design. The advent of tricolor picture tubes with most exacting deflection requirements has necessitated a renewed search for better design techniques. In the course of this search, deflection field configurations were studied and the utility of the field plot established in both the empirical and analytical[5,6] approaches to the deflection problem.

The Field

An electron beam has an appreciable thickness and in the process of being focused on the phosphor screen, takes on a long, thin conical shape. The greater the deviation from the ideal (infinitely-thin) cylindrically shaped beam and the greater the angle of deflection, the more serious are the defocusing and raster distortion effects[7]. In the three-gun tricolor tube, the cluster of three beams behaves like an extra-thick composite beam having an extra-large convergence angle and aberration effects are severe. The elimination of deflection aberrations is usually the major problem in the design of deflection yokes.

In the following discussion, the horizontal and vertical magnetic

Deflection Yoke Design

Simple method of analysis permits accurate measurement of differences in performance caused by design changes. Specific deflection responses may be attributed to specific design changes. Need for manipulating cathode-ray tubes is minimized

fields of the television yoke will be identified by the symbols: H = magnitude of the field set up by current in horizontal deflection windings and V = magnitude of the field set up by current in vertical deflection windings.

Since both fields follow the same laws of physics, only one field H is to be studied and the conclusions reached applied, in principle, to the other field.

A magnetic field is a vector quantity which can be visualized as the resultant of component vectors directed along the three axes of a system of Cartesian coordinates, Fig. 1. The three components of the H field will be designated H_x, H_y, and H_z. Since the H_y component is the one which produces horizontal deflection (x direction), it will receive the most attention.

Figure 1 depicts also the manner in which the H_y component varies in a typical television yoke. The H_y component is explored along x, y and z axes. Cross-sectional sketches of side and end views of the windings serve to locate the plotted points in space with reference to the physical windings. The points A, B, C, D and E are common on all three sets of curves.

As a further aid in visualizing field configurations it is sometimes helpful to build a space model such as that shown in the photograph. This is a plot of the H_y component throughout the xz plane. The base of the model represents the xz plane which bisects the horizontal windings and the height of the curves above the base represents the relative magnitude of field component in the xz plane. Mathematically, the surface formed by the curves expresses H_y as a function of x and z, or $H_y(x, z)$.

The sets of line plots employed here are those most useful in practice namely: The $H_y(x)$ function expressed in a family of curves taken along lines paralleling the x axis and the H_z function defined as the single curve $H_y(z)$ taken along the z axis proper. In the photo-

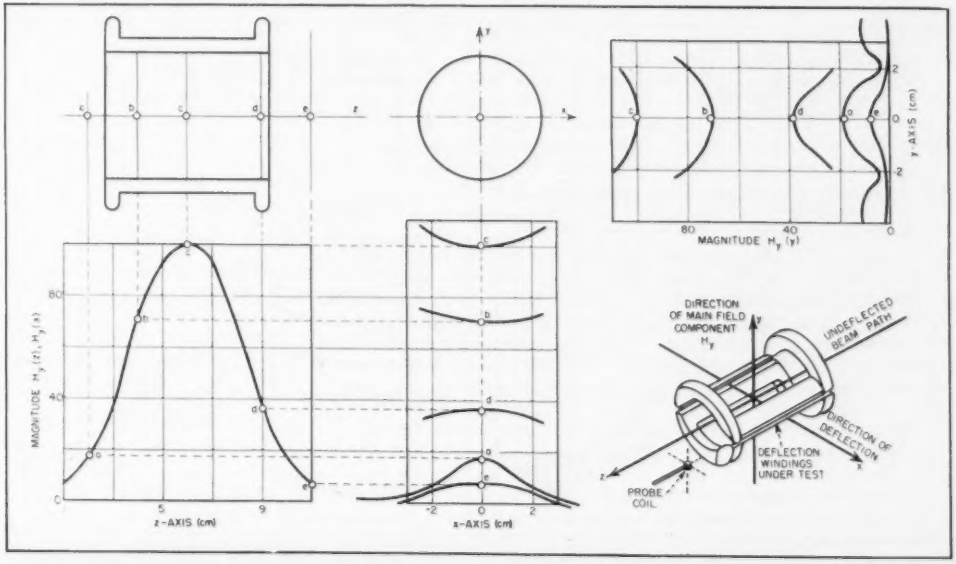

FIG. 1—The H_y field plot of a commercial yoke and a mechanical sketch showing the coordinate axes

graph, this curve is the dark line joining the midpoints of the successive $H_y(x)$ curves.

A complete picture of the field would require a discouragingly large number of plots in families of curves H_y (x), H_y (y), H_y (z), repeating all for H_x (x,y,z) and H_z (x,y,z). In practice a modest number of plots suffices. A specific problem often involves restricted areas of interest, so that only those areas need be explored. Advantage may be taken of the similarities exhibited by field characteristics in different regions plotted, reducing the number of curves necessary to supply desired information. For the H field, the H_y component is the dominant one. In the region of the main field, the H_x and H_z components are insignificantly small and need not be explored extensively.

Empirical-Design Plots

The ultimate criterion of a deflection yoke design is its performance on a picture tube, but the use of field plots provides unique advantages in analyzing and evaluating the numerous expedients used in reaching the design. It is a simple method of analysis that minimizes the need for manipulating cathode-ray tubes, always troublesome in experimental work. Whereas observations on picture tubes are subject to considerable error, the field-plotting technique permits accurate measurement of differences in performance caused by various design alterations. It becomes practicable to attribute specific deflection responses to specific design changes.

The degree of deflection produced by a winding geometry is proportional to the field intensity set up by the winding with a given current flow. To a first approximation, the integrated area under the H_z plot is a measure of the total deflection produced in a picture tube. When comparing plots, one must keep in mind the values of current required to produce the fields, as well as the relative inductances of the windings used in the comparison.[1]

Field plots reveal the amount of useful magnetic component present as compared to the remaining, usually troublesome, components. The field produced outside possible beam

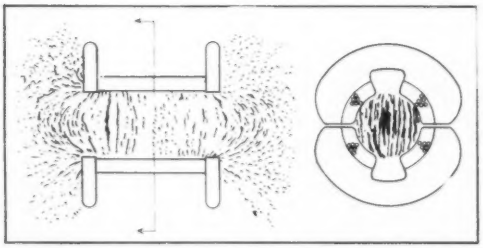

FIG. 2—Iron-filing plot of a uniformly-distributed winding and resulting barrel-shaped field

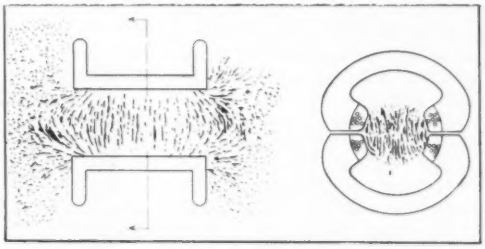

FIG. 3—Iron-filing plot of a concentrated winding and pincushion field

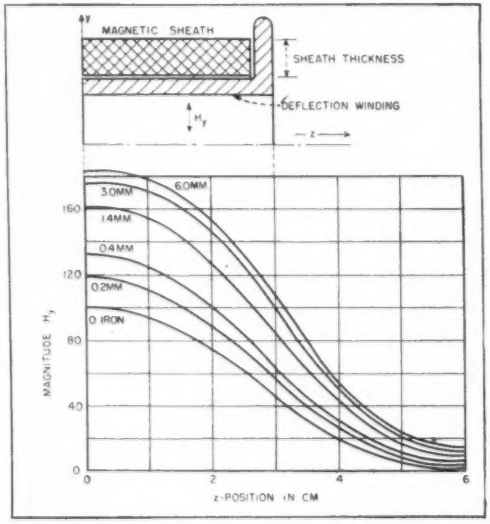

FIG. 4—Deflection field as a function of magnetic-sheath thickness

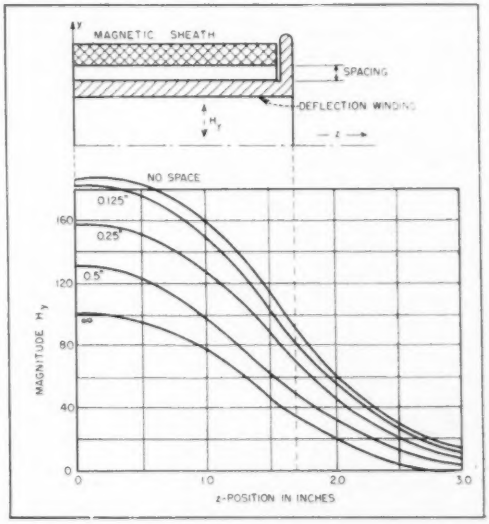

FIG. 5—Deflection field as a function of magnetic-sheath spacing

paths is wasteful of power since it has no effect on deflection. The involved fringe field may be studied effectively also by exploring all components.

With large deflection angles, avoidance of neck shadow may require a concentration of the field in the flared region of the tube neck. By contrast, in conventional yokes (Fig. 1), the build-up of area under the H_z curve indicates that the bulk of deflection occurs well before the beam enters the flared neck of the picture tube, which is the screen end of the deflection winding. With the help of field plots, a more efficient concentration of field can be obtained.

Pattern Distortion

Shaping the deflection field has a profound effect upon raster distortion.[5] Even if the ideal uniform field could be obtained ($H_x = 0$), the flat or near-flat geometry of the conventional tube face would cause a pincushion-shaped distortion to appear on the tube screen. The perfect raster would be formed on a spherical screen surface. To eliminate the raster distortion, an equal and opposite distortion may be introduced by curving the deflection field appropriately. It may be shown[6] that a barrel-shaped distortion in the raster is produced by a pincushion-shaped field. Conversely, a pincushion distortion is introduced by a barrel-shaped field.

Figures 2 and 3 illustrate these two field configurations obtained experimentally. In these illustrations, iron-filing pictures were made in d-c excited windings. Unlike the other field plots appearing graphically in this discussion, Fig. 2 and 3 each show combinations of two field components (H_z and H_x in the lengthwise view and H_x and H_y in the end-on view). These are isometric plots of the field, loci of points of the same intensity, in the cross-sectional planes indicated.

Winding Geometry

Winding geometry may be studied effectively with field plots. Whereas uniform distribution of conductors on the circumference of the tube neck tends toward generation of the barrel-shaped field of Fig. 2, a relatively concentrated winding generates the pincushion-shaped field of Fig. 3. Present-day commercial yoke windings often utilize a type of conductor distribution wherein the number of conductors in a small arc on the circumference varies as the cosine of the angular location of the arc with reference to the direction of deflection. In each cosine-type winding, the main curves expressing H_y (x) will tend to be straight lines.

The curvature in plots of H_y (x) is related to the curvature illustrated by the iron-filing pictures. The H_y (x) plot of the barrel-shaped field would show the field intensity dropping off toward the ends of the plot. The H_y (x) plot of the pincushion-shaped field would show the field intensity increasing at the ends of the plot. Both curvatures can be seen in the plot of Fig. 1.

Shaping of the field is effective in minimizing spot distortion. For better focusing over the face of the usual picture tube, a deflection yoke should have a field characteristic H_y least intense at the center of the yoke and increasing slightly in intensity with distance along the x axis, the direction of deflection. This is a pincushion-shaped field. In practice, a form of conductor arrangement approaching the cosine-squared distribution has proven advantageous. The role of field plotting in such a result is obvious.

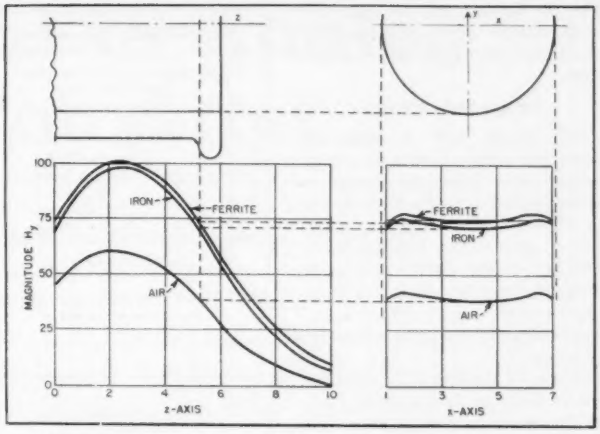

FIG. 6—Suitability of different sheath materials may readily be evaluated

Field plots are useful in studying the effects of ferromagnetic materials in deflection windings. Figure 4 was plotted with constant current in the winding, varying the thickness of the ring or sheath of magnetic material. The curves show that with increasing thickness of sheath, the field intensity increases until a ring depth is reached above which there is a negligible increase in intensity. It is interesting to note that the relative shape of the curves remains practically the same in all cases, only the magnitude changing. The corresponding curves of H_y (x) and H_y (y), although not illustrated, follow the same rule.

Air Space

Figure 5 reveals a further result of investigating magnetic sheaths. The air space within the yoke, through which the beam travels, is the dominant factor in fixing the reluctance of the magnetic flux path. A ferromagnetic sheath provides a low-reluctance return path for the flux. Spacing the sheath from the windings lengthens the air gap in the magnetic path and thereby affects the field intensity.

In Fig. 6, field plots are used to compare the effectiveness of different magnetic materials having the same physical dimensions. There is little difference in the two results. Evidently the reluctance of the return path of the field flux is reduced to a negligible value in either case;

a choice between the two materials must depend upon considerations other than their relative permeabilities.

Fringe-Field Effects

The fringe field in deflection yokes has always been a source of uncertainty. From an inspection of the preceding field plots it should be evident that there is no sharp line of demarcation between main field and fringe fields. Figure 7 shows one way in which field plots may be used to study fringe fields. The same deflection yoke is used in each case.

In one of the trials the winding end is flared to fit the flared neck of the television picture tube. In another trial, the winding end is spaced off the tube neck but is not flared as in the first trial. The curves show the corresponding effects on the field. More detailed conclusions may be reached only after exploration of the other components involved in the three alternatives and an evaluation of their influence upon deflection and spot focus.

The classical treatment of deflection appears to have originated in German laboratories[4] and has been expanded upon in this country. All such approaches pre-suppose a knowledge of field distributions. Conceivably, these may be calculated but even in the simplest cases, the calculation proves so laborious that an experimental determination of the field becomes a necessity.

Utility of the field plot may be shown by a theoretical analysis involving beam deflection.[5] In such an analysis, two-dimensional fields (components in x and y directions only) are used and the work is restricted to field types which have mirror symmetry about the xz and yz planes. The vertically deflecting and horizontally deflecting fields exist simultaneously in the same region.

It is interesting to note that any magnetic-field nonuniformity which a field plot discloses is evidence that the flux lines of the field are curved in that region. Any curvature in the plot of a field component discloses the existence of another field component.

Studies involving the mathematics of deflection may well lead to yoke designs having a minimum of deflection distortions.

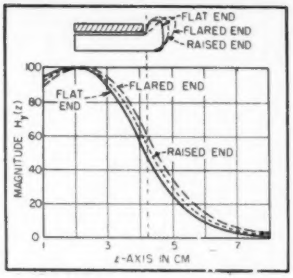

FIG. 7—Field plots show effect of forming the winding end

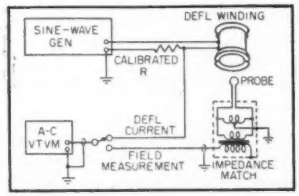

FIG. 8—Block-schematic diagram of the test equipment

Equipment

Figure 8 outlines the equipment used for measuring the deflection field. Sine-wave currents are used in the yoke windings and a calibrated series resistor provides a means for measuring the current flow.

Stable, sensitive and precise equipment is readily available for generating and measuring sine waves, a waveform which is easily controlled and offers a minimum of difficulty in calibrations and computations.

To approximate dynamic operating conditions, a frequency of 15 or 16 kc is used in the horizontal windings and approximately 1 kc in the vertical windings. The latter frequency is low enough to avoid deleterious effects of frequency, yet high enough to permit field exploration with the low-impedance probe coil used.

The probe coil consists of approximately 200 turns of No. 42 wire, wound on a nylon form having winding space of 0.040 in. inside diameter, 0.120 in. outside diameter and 0.040 in. wide. The terminal wires connect to a miniature type step-up transformer feeding a sensitive vacuum-tube voltmeter which serves to indicate field strength.

A second photograph shows the field-plotting equipment, essentially a mechanism for locating the exploring coil accurately in all parts of the magnetic field of a deflection winding along each of three mutually perpendicular coordinate axes. The probe coil may be rotated fully about the longitudinal axis of the probe rod.

In the field area, construction is nonmetallic to avoid distortion of the field under test. The probe rod is of plastic material. Electrostatic pickup is minimized by using a carefully balanced bifilar winding centertapped to ground at the probe terminals. The transformer and this balancing winding, for reasons of magnetic shielding, are housed in a thick-walled iron shell located at the base of the probe rod. This shell functions as a plunger which rides in a bored casing of squared cross-section and acts as a support and guide for moving the probe along the z axis in the direction of the probe rod. Precautions must be taken to avoid operating the equipment in the presence of interfering fields. The 60-cycle pickup which is encountered in the vicinity of voltage-regulating line transformers is particularly objectionable.

Credit is due Fred Clair, John Kackauskas, William Hoenig and Daryl Shipley for contributions in this work.

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Digital to Analog Converter

By M. MILLER, B. L. WADDELL and J. PATMORE

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Information stored in digital systems, such as business machine cards and magnetic tapes, is changed to analog form for application to industrial processes requiring d-c control voltages, or to analog-type plotting boards for rapid interpretation

INFORMATION STORAGE, whether it be data concerning the performance of a guided missile or the rise and fall of bobby pin sales, whether in analog form such as a curve plotted by two variables or in digital form such as columns of figures, pulses on magnetic tape, or holes punched in cards or tape, can be represented through the medium of numbers.

The information stored in several thousand numbers expressing, for example, the performance of a turbo jet engine under test, becomes extremely hard to evaluate. The digital information might be reduced to analog form by some plotting method for rapid interpretation, but this operation usually is accomplished manually at the cost of speed and accuracy.

The digital-to-analog converter is intended to automatize plotting of digital information without materially sacrificing the speed or affecting the accuracy of the digital system. The converter can be used in applications other than digital plotting, such as, furnishing input data to analog computers, or as an electronic control for industrial processes. However, development of the converter was initiated primarily so that digital information from IBM cards could be plotted.

The function of the converter is that of transforming digital data into d-c voltages for plotting and recording, and the equipment can be attended readily by non-engineering operating personnel.

The basic elements of the converter, as shown by the block diagram of Fig. 1, are a basic timer, two temporary storage units, two d-c converters and a control panel.

Operation

In operation, two four-digit numbers and their signs recorded on an IBM card are read by a type 513, 517, or 523 IBM card machine. This information is stored in the temporary storage units until the card-reading cycle is completed and the two numbers assembled. While the numbers are being assembled, the two d-c converter units switch in precision resistors in a voltage-divider arrangement. The resultant voltages are summed in the d-c amplifiers and the output, which is proportional to the digital input, is applied to the plotting board servo system to position a pen and plot a point.

Each card has eighty columns across its width, each column numbered from zero through nine from top to bottom. Two other positions arranged above the zero at the top of the card will be considered as the eleventh and twelfth numbers. During the card-reading cycle, the IBM machine emits a series of pulses which indicate the particular line the machine is reading.

The eleventh position is used to indicate the sign of the number, a hole punch in this position indicating that the whole number is negative, and no punch a positive number. In recording the number on the card, the sign may be indicated in any column of the four-digit number. Regardless in which column the sign appears, the converter will detect it and cause the

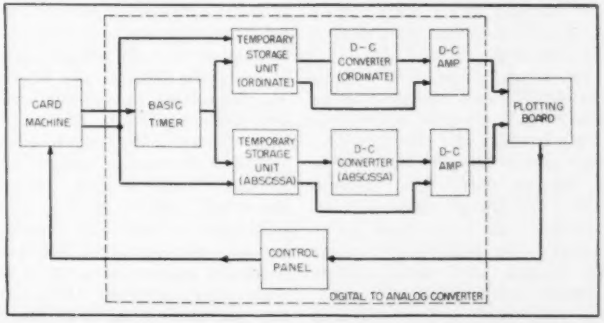


FIG. 1—Block diagram shows principle of digital to analog converter

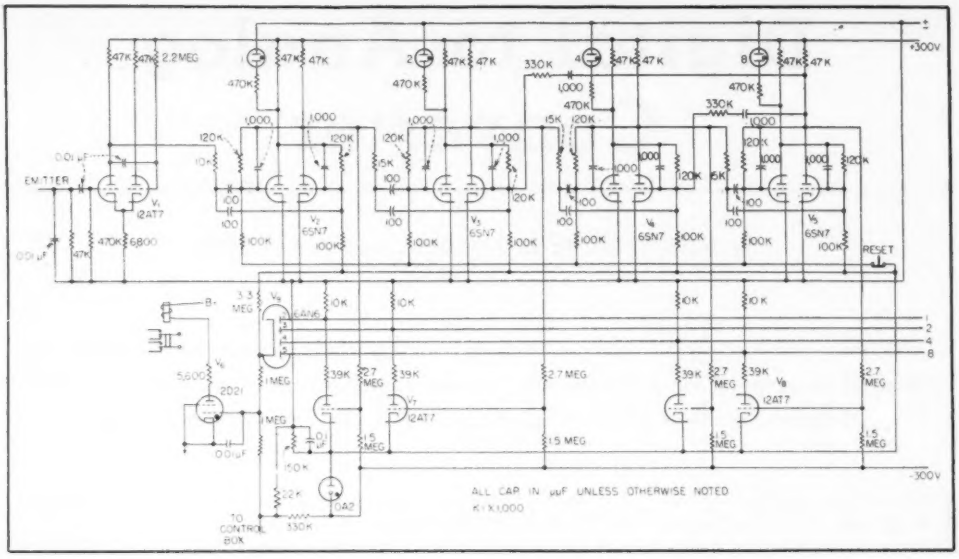


FIG. 2—Converter basic timer consists of a pulse shaper and four multivibrators and isolation amplifiers

resultant d-c voltage output to be either positive or negative.

Basic Timer

The converter basic timer (Fig. 2) consists of a pulse shaper, four Eccles-Jordan multivibrators, and four associated isolating amplifiers used to furnish control voltages to the temporary storage units. The 12AT7 pulse shaper V_1 insures that the emiter pulses are clear and well defined, for dependable and accurate operation. The timer counts from nine through zero in a coded binary form, that is, with the first emitter pulse the Eccles-Jordan circuit registers nine, indicated by the numbers one and eight. This corresponds to the nine-line being read on the IBM card.

The second pulse for the eight-line is indicated by the number eight. The third pulse is indicated by the numbers one, two, and four, representing the seven-line, and so on through zero. The eleventh pulse, indicating sign, is not handled in the basic timer but is applied to the appropriate temporary storage unit which selects a positive or negative voltage.

A self-checking circuit is included which compares the count of the timer against the zero emitter pulse. If the basic timer is not on zero, a thyratron is fired which pulls in an error relay causing a buzzer to operate, simultaneously, the operation of the IBM machine and the converter are stopped so that the d-c output voltage for that pulse will not be plotted. Indicator lights on the front panel show which multivibrator failed, and also show the number of pulses missed during that cycle. A reset button is provided, which when operated, will reset the basic timer to zero.

Temporary Storage Units

Two temporary storage units hold the ordinate and abscissa numbers while they are being assembled and converted to d-c voltages. Each storage unit (Fig. 3) has a pulse-shaping section, an isolating amplifier, and a matrix or number assembly (storing thyratron) section.

The pulse-shaping section uses five 12AT7 dual triodes. Four of the triode sections receive pulses produced by the IBM machine brushes when a punched hole is encountered on the card in any of the four number columns. Two tubes are used as isolating amplifiers to provide half-control voltages to the matrix. The fifth pulse shaper fed by the eleven-line emitter pulse is arranged to furnish half-control voltage to a sign-changing thyratron. The other half-control voltage is obtained when a punched hole appears on the eleventh line in any column of the IBM card. When this occurs, the appropriate IBM column brush, pulse shaper, and isolating amplifier feed a voltage to one plate of a 6AN6 diode and from there to the control grid of the sign-changing thyratron. The thyratron in turn will fire and operate a relay which selects either positive or negative voltage in the d-c converter.

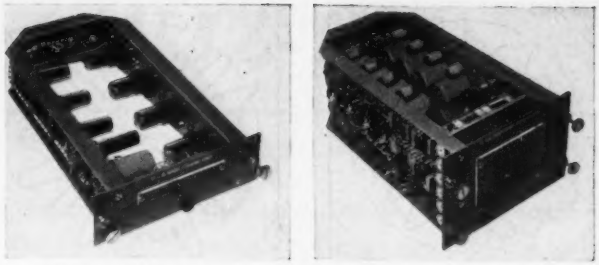
D-C Converter

The two d-c converters accomplish the actual changing of digital information to d-c voltages. When a thyratron is fired in the matrix a relay is operated, connecting a precision resistor in a voltage-divider circuit. When the whole number is assembled by this resistor selection process, the resultant voltages are summed in a contact-stabilized d-c amplifier and applied to the plotter. The sign of the voltage is determined by the presence or absence of a hole on the

eleventh line of the card.

The converter unit has been provided with a control circuit to provide operate pulses to the auxiliary devices and control starting and stopping of the converter. The check circuits operate through the control circuits and provide stops to suspend operation if an error occurs. The control circuits allow different auxiliary devices to be connected without rewiring.

The control panel contains a power on-off switch, automatic-manual feed, a manual pushbutton, and a storage clear. The control circuit also provides parallax and scale factor controls previous to the d-c amplifiers to allow the summing inputs to be modified according to the requirements of the digital input.



Basic timer (left) and temporary storage unit (right) form basis of converter

Sequence of Operation

Let us assume that one of the two numbers punched in an IBM card is —1952. As the card-reading operation proceeds, a pulse is received from the IBM emitter which indicates that the nine-line is being read. This pulse, which is fed to the basic timer, causes the first and fourth Eccles-Jordan multivibrators to go on, representing the numbers one and eight, or the coded binary equivalent of the number nine.

When the two stages of the basic timer go on they cause a voltage, amounting to half control voltage, to be applied to thyratron rows one and eight in the matrix. At the same time that the nine-line pulse is produced, a brush riding the second column of the card makes contact through the punched hole representing the nine of the whole number 1952.

This contact produces a pulse which is fed to the temporary storage unit (Fig. 3) where one-half of the control voltage required to fire the thyratron is formed. This voltage is then applied to all of the thyratrons in the second or hundreds column. Since thyratron rows one and eight have received half their required control voltage from the basic timer, this additional voltage is then sufficient to fire thyratrons one and eight in the second column only. These thyratrons, in turn, cause relays to switch appropriate resistors into the voltage divider of the d-c converter.

At this point we have achieved temporary storage of the number nine and partial conversion of the whole number into d-c voltage. As the card-reading cycle continues, the remaining lines of the IBM card are read in the same manner as described above until the whole number and its sign are stored and converted. The total d-c voltage produced is fed to the plotter. For this application, the plotter has been arranged to plot a point only after its servo system and associated pen have come to a complete null, thereby realizing the maximum possible accuracy.

Applications

The digital to analog converter has many applications. The d-c outputs can be used to control manufacturing processes. This application allows uniformity of information from day-to-day or hour-to-hour control. The digits or control number used at time t_1 will have the same d-c value at time t_2. The change in controlled process can be easily effected by giving the device new numbers to operate on in the form of new IBM cards, new list for keyboard operation, or a new magnetic tape.

The data reduction flexibility of the device can be seen from the fact that d-c or analog comparator techniques can be applied between the d-c amplifier and the plotting board; that is, multiplication by a constant, or subtraction or integration previous to the plot. Thus, the engineer can try many different parameter combinations on his test data and receive a plot of the results of his changes almost simultaneously.

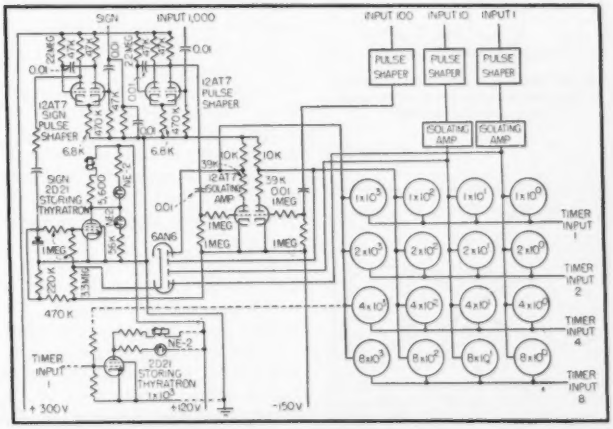


FIG. 3—Two storage units hold ordinate and abscissa numbers while they are being assembled and converted to d-c voltages

Skewed

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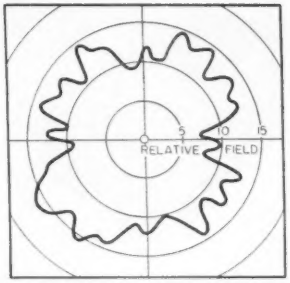


FIG. 1—Measured pattern in relative field strength of four-element skewed group mounted on circle of 4.2 wavelengths diameter

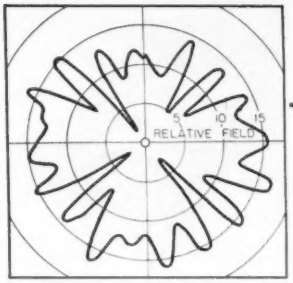


FIG. 2—Measured pattern in relative field strength of antenna group with four-element conventional orientation that causes dips

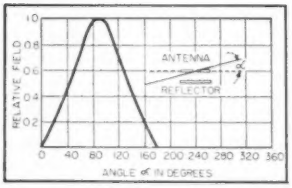


FIG. 3—Simplified calculated curve of antenna field vs angle for individual radiator. Backward radiation is not considered

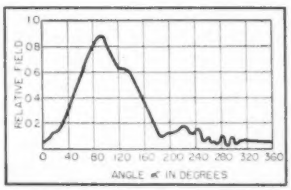


FIG. 4—Actual measured pattern of individual radiator. Undesired backward radiation deepens nulls of final array pattern

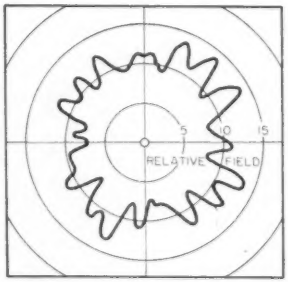


FIG. 5—Measured pattern from vertically-polarized elements. This polarization is not used for television

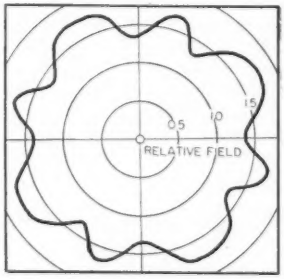


FIG. 6—Midchannel calculated pattern of the skew antenna showing the relatively uniform coverage

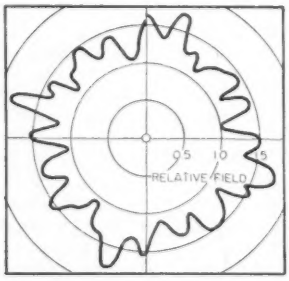


FIG. 7—Midchannel measured pattern showing effect of Fig. 4

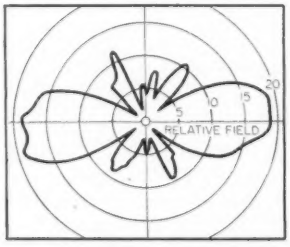


FIG. 8—Average vertical pattern of the standby array scale model

TELEVISION broadcasting stations find it highly practical from a commercial viewpoint, to have available a completely separate standby transmitting antenna system. At the Empire State Building in New York City, one of the five prominent antenna positions is occupied by WJZ-TV. The conical portion of the building directly beneath the five- antenna tower is allotted to them for a standby radiator.

Skew Method

The normal method of installing radiators employs four directive antennas beamed away from the center, each covering one-fourth of the azimuthal range. It is customary in this case, to use the supporting tower surface as a reflector and produce a directive beam with a simple half-wave radiator.

A new arrangement, in which the simulated tower faces have been extended in one direction to produce reflectors at 90 degrees with respect to radial directions, is shown in the photograph. Now the half-wave radiators, turned 90 degrees from their former positions, produce beams that are skewed 90 degrees.

Halfway between the beams, in both cases, is a crossover angle, at which the radiation is equal from two adjacent radiators. The phasing can be chosen to give the desired relative signal at this angle but at other angles near it the resultant signal depends on the several chosen fixed conditions.

When there is no skew, the rate

Antenna at WJZ-TV

Standby radiator comprises four corner-reflector units mounted on the conical tower below regular tv antennas. Elements skewed 90 degrees smooth radiation contours that would otherwise suffer dips from interference patterns resulting from mounting elements tangent to frustum of the cone

of change of the phase between the individual radiated signals varies rapidly as the angle changes and the pattern develops relatively deep null values. When there is 90-degree skew, this rate of change of phase is much slower so that the pattern nulls are less prominent.

Initial work made use of an experimental setup of four antennas mounted on a circle of 4.2 wavelengths diameter. In the particular case the antennas were skewed at 90 degrees. Because of the horizontal polarization it was important to drop the individual cables considerably below the level of the antennas for the interconnections. Each antenna was a corner-reflector type, giving good control of both planes of polarization.

The experimental curve obtained with this arrangement is given in Fig. 1. Figure 2 gives the result when the skew is reduced to zero. The improvement by the use of a skew angle is quite apparent. Calculations have been made for comparison with the experimental data. Figures 3 and 4 show the calculated and measured curves for the individual radiators. Figure 3 is based on the forward radiation obtained from a commercial corner-reflector antenna. The backward radiation was eliminated to reduce computation and the sources were assumed to be points, in order further to simplify the work.

Although the principal concern in this study was horizontal polarization because of its application to tv, it should be noted that there is nothing about the skew technique that is restricted by polarization. To demonstrate the point the experimental curve of Fig. 5 is shown for which the corner-reflector radiators were vertically polarized.

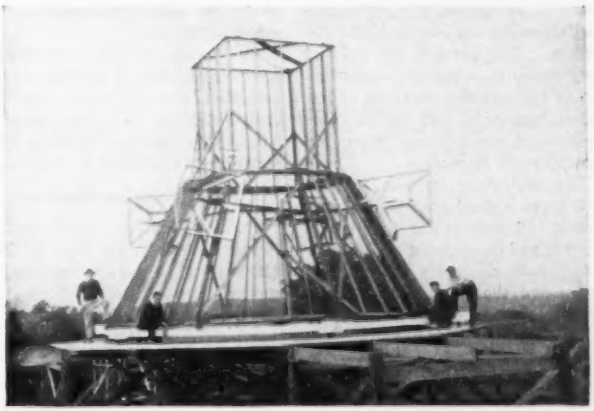
Empire State Mockup

The WJZ-TV antenna was given a full-scale test at our laboratory site in Orland Park. The conical portion of the building and a short lower section of the antenna tower were reproduced in wire mesh. The entire arrangement was rotated for horizontal patterns. Earlier tests on a model basis were used to obtain the vertical patterns so that the antenna gain could be calculated.

Figures 6 and 7 show respectively the calculated and measured patterns at midchannel. Better agreement between them is prevented by the limitations of the individual pattern, shown by Fig. 4. The presence of undesired backward radiation introduces interference and results in doubling the number of radiation lobes and deepening the nulls.

Figure 8 is the average vertical pattern obtained from the scale model. It can be shown that the gain of the antenna system as compared with a half-wave dipole antenna is unity.

We are indebted to V. J. Andrew for the origin of the skew principle and to R. E. Green and A. Wojnowski for assistance in calculating numerous patterns and for the experimental work.



Full-scale mockup of the Empire State tower section showing three of the corner-reflector radiators mounted at 90 degrees

Closed Loop Controls Human Centrifuge

Electronically-controlled 4,000-hp motor accelerates massive human centrifuge from rest to 173 mph in 7 seconds. Gimbal-control motors produce any desired stress concentration. Centrifuge is designed to test airborne electronic gear and pilots' G-suits

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ACCELERATION FORCES up to 40 g are developed by the human centrifuge at NADC, Johnsville, Pa. The centrifuge simulates stresses encountered in high-speed flight and will be used to conduct research into biological effect of forces developed in aircraft, in testing airborne electronic equipment and in developing protective clothing for pilots.

As shown in the photograph, the 180-ton centrifuge consists of a 50-foot tubular-steel arm attached to the shaft of a 4,000-hp motor. At the end of the arm is an oblate spheroidal gondola. The gondola is mounted in gimbal supports and positioned by an electrohydraulic system. This permits the axis of the gondola to be positioned continuously through the resultant of the radial, tangential, and vertical components of acceleration when the centrifuge is in motion.

The centrifuge may be accelerated from a dead stop to approximately 173 mph in less than seven seconds and decelerated at the same rate. Both the main accelerating motor and the two gimbal control motors are electronically controlled using closed-loop systems.

Instrumentation

Close study of the subject in the gondola is accomplished by television, motion-picture cameras, high-speed x-ray equipment and special physiological sensing and measuring equipment. Gimbal motor control information, television signals and output from physiological sensing devices are linked to control stations through rhodium-plated slip rings on the main rotor shaft. The entire centrifuge room is shielded with ⅛-inch copper against electrical and magnetic interference.

Braking is accomplished using a photoelectric relay. When the centrifuge in decelerating reaches a rate of three rpm, a light source on the end of the arm activates a phototube relay that reduces the speed to 0.5 rpm.

As the light source passes a second phototube, a second relay is activated that in turn sets the brakes and the centrifuge comes to a dead stop opposite the retractable platform in the chamber wall.

Acceleration Motor

The acceleration motor control circuit is shown in Fig. 1. The 4,200-hp synchronous motor is started as an induction motor. When its speed reaches a predetermined value, the motor is automatically thrown across the 4,160-volt a-c line.

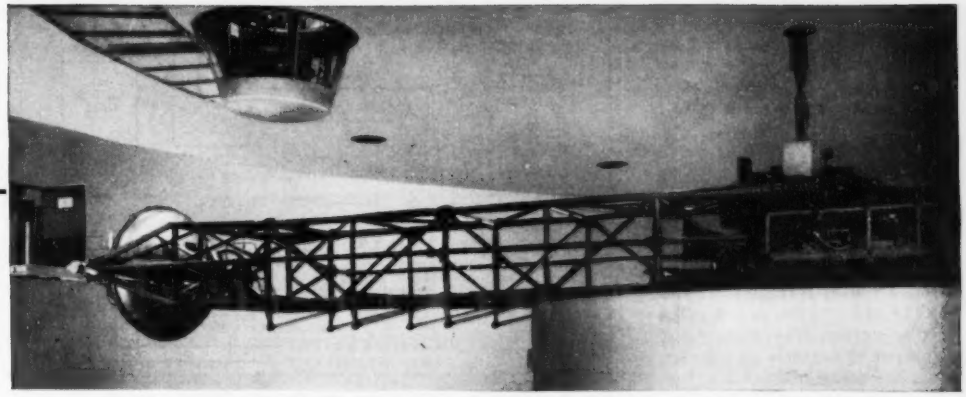
The field of the 4,200-hp motor is supplied by a voltage-regulator-controlled exciter mounted on the motor shaft. Also, on this shaft are two 1,500-kw d-c generators. These generators are connected in parallel and supply power to drive the 4,000-hp accelerator motor. Two speed ranges, 0 to 29.8 rpm and 0 to 48.5 rpm are made available by splitting the generator fields for either parallel or series connection.

The fields of the d-c generators are supplied by two electronically controlled 32.5-kw amplidyne generators. The amplidynes are driven by a 100-hp synchronous motor. Their output is a function of the difference between the actual speed of the accelerator motor and the speed called for by the operator or automatic program cam. This difference voltage is introduced to the amplidyne fields through the electronic amplifier.

Amplifier Control Panel

The operator in the overhead control-blister selects the desired type of operation, either by hand throttle, or by means of automatic program cam, or by the subject in the gondola.

The amplifier control panel, shown in Fig. 2, contains the outputs from three potentiometer controls. From the position of the potentiometer in use, a reference voltage is obtained that is balanced against the tachometer output voltage. Part of the difference voltage



Subject rides gondola at end of 50-foot boom. Operator controls test from overhead control blister. Gimbal-mounted gondola is brought to positive stop opposite retractable access port by phototube-controlled braking system

is applied to the grid of the control amplifier. Calling for increased speed raises the output voltage from the amplifier and will keep it raised until the tachometer generator output and the voltage being called for are equalized.

Limit-Balance Panel

The output from the amplifier-control panel is trimmed in the limit-balance control panel. Here also are introduced, two voltages, proportional to the portions of the accelerator motor field supplied by generators *A* and *B*, respectively. When the load is equally divided between the two generators, the voltages cancel. However, should one generator supply more current than the other, current will pass through the control coil of a kenotron (a high vacuum diode whose plate current is controlled by a magnetic field). The unbalanced load drives the tube beyond cutoff raising the signal level of the generator not bearing its share of the load and lowering the signal of the other until balance is restored.

Current-Limit Panel

In the current-limit control panel, a voltage is introduced proportional to each generator's armature current. Two magnetically-controlled kenotrons are used for each generator, one for forward current and one for reverse current. As limiting current is reached, the appropriate kenotron is cut off. In this manner, the increased signal potential is dissipated in fixed resistors thus limiting the current.

Part of the output voltage from the generators is used as a bias source providing negative, adjustable feedback to aid in system stabilization.

Rectifier Panel

The control signal is applied to the rectifier panel that consists of two banks of four push-pull 807's each. The first bank has the amplidyne buck field in its plate circuit; while the second bank has the boost field in its plate circuit. Both banks have a common cathode potentiometer set for maximum amplidyne field current. Current through the buck and boost fields is held equal at zero signal input. Calling for increased speed lowers the input signal to the first group of 807's, decreasing current in the buck field. Because of the common cathode resistor, current flow is increased in the boost field. The main generator field is strengthened resulting in higher generator output and increased motor torque

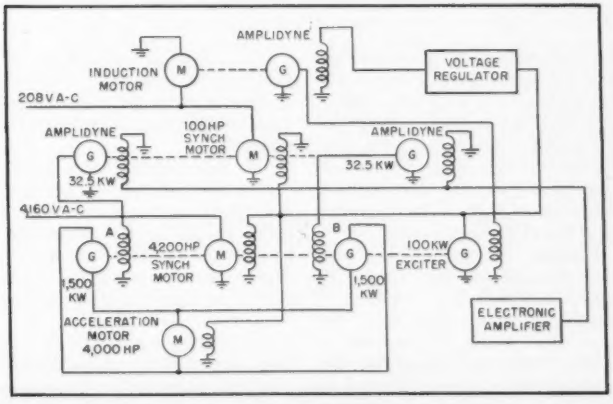


FIG. 1—Accelerator-motor control system. Electronic amplifier controls amplidynes supplying fields to dual d-c generators driving motor

to accelerate the centrifuge.

The gimbal control motors, 75 hp for the outer gimbal, 40 hp for the inner gimbal, drive the gimbal rings through shafts running the length of the arm.

Gimbal Control

The gimbal control system, shown in Fig. 3, is designed to control accurately the movement of a gimbal ring using two parallel closed loops. One is responsive to input angular position and the other to input angular velocity. The angular-position loop uses a pair of selsyns to generate an angular-position error signal.

The angular velocity-loop employs a tachometer generator and linear potentiometer to obtain a differentiated voltage proportional to the rate of change or angular velocity of the input.

The selsyn error signal is fed to a phase-sensitive detector. The d-c voltage appearing across the output varies in magnitude with the magnitude of the error signal.

The error signal is also applied to a second amplifier and detector combination. When the d-c voltage output of this detector exceeds a predetermined value (error signal for approximately 4 degrees), an emergency circuit is actuated that stops the centrifuge since the gimbal rings are not following the operator's commands within specified limits. This arrangement also prevents starting if control and gimbal positions are not synchronized with those being called for by the operator or program cam.

In the derivative amplifier, variation of the linear potentiometer changes bias of the input tube. From an R-C network in the plate circuit of the input tube, a voltage is obtained proportional to the time derivative of angular movement of the potentiometer. This voltage is fed to a push-pull d-c amplifier and cathode follower. The output of this circuit varies in proportion to the desired angular velocity set up on the linear control potentiometer.

Mixing and Stabilizing

Output from the phase-sensitive detector, derivative amplifier, and tachometer generator are algebraically summed and inserted into the mixing and stabilizing panel. The resultant is fed to a push-pull d-c amplifier that excites the gimbal solenoid coils in accordance with angular and velocity error signals. The solenoid controls the hydraulic amplifier and transmission.

Rotation of the outer gimbal ring through 90 deg. results in approximately 5 deg. rotation of the inner gimbal ring with the inner gimbal ring not powered. A selsyn differential driven by the outer gimbal shaft is connected in the selsyn circuit and compensates for differential gearing.

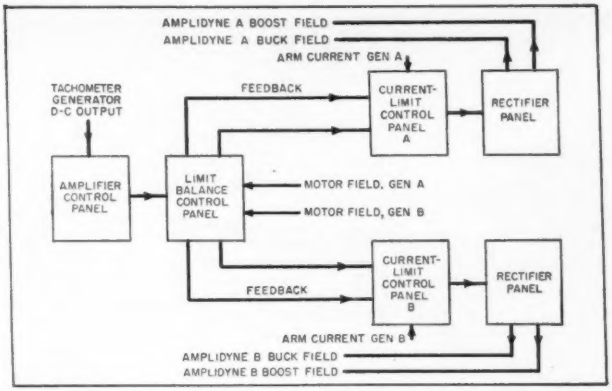


FIG. 2—Closed-loop motor control system uses difference voltage between tachometer d-c output and voltage picked off control potentiometer

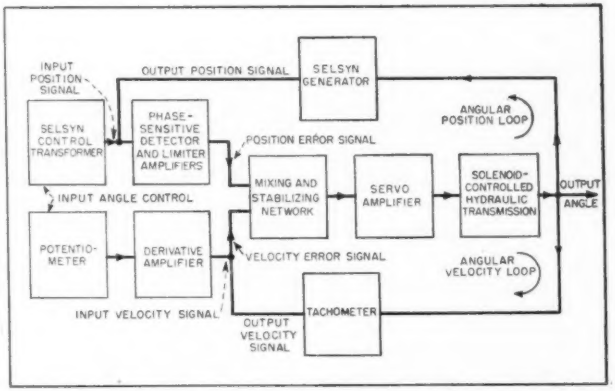


FIG. 3—Gimbal-control system employs parallel closed loops responsive to both angular position and velocity

With this control system, the inner gimbal ring may be rotated and the gondola tumbled at a rate variable from 0 to 30 rpm in either direction.

The outer gimbal ring permits tilting the gondola through a 90 deg. about a horizontal axis at right angles to the longitudinal axis of the centrifuge arm. This 90-deg. movement may be accomplished in approximately one second.

The cooperation of the General Electric Company and the McKiernan-Terry Corporation in the preparation of this article is sincerely appreciated by the author.

How To Design VR Tube Circuits

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Direct approach for determining optimum design on the basis of a stated set of requirements saves time and paper work. Family of curves for various tube types is the key to a quick solution of VR tube circuit-design problems

VOLTAGE-REGULATOR tubes of the gaseous glow-discharge type find many applications in d-c voltage supplies required to deliver fixed output voltages with moderately good regulation.

For the circuit designer, the problem frequently becomes one of design by successive approximations. A more satisfactory design procedure would be to employ a direct approach to the synthesis of an optimum design on the basis of a stated set of requirements. Such a procedure may be based on the accompanying charts, which have been developed as described below.

Table I lists the most significant electrical characteristics of six popular types of gaseous voltage-regulator tubes. These characteristics include the nominal d-c voltage at which the tube operates, E_T, the supply voltage which must be available to the tube in its unfired condition to insure that firing will occur, E_F, and the maximum and minimum values of current drawn by the tube itself to insure satisfactory operation of the tube, $I_{T\max}$ and $I_{T\min}$, respectively.

Figure 1 shows a simplified schematic of a typical power supply employing a VR tube. Battery E_s represents the open-circuit voltage of the supply to the VR tube, essentially the no-load output voltage of the transformer-rectifier-filter combination used in most applications. Resistor R_s is equivalent to the internal resistance of the supply to the VR tube. It includes the effective resistance of the transformer-rectifier combination and the d-c resistance of any filter chokes in addition to the lumped series resistance deliberately inserted in the VR tube supply.

Although the total series resistance R_s is ordinarily not constant as a function of current because of the nonlinear characteristics of the rectifier-filter, it may be considered so for most practical purposes. This is so because the nonlinear components of the resistance are ordinarily a small portion of the total. The voltage developed across the load in Fig. 1 is equal to E_T for the VR tube employed when the tube has fired and is operating normally.

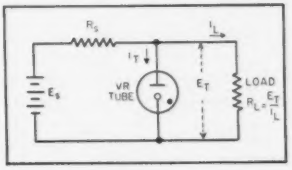

FIG. 1—Simplified schematic diagram of a typical power supply using a V-R tube

The current drawn by the VR tube itself is represented as I_T, and that drawn by the load at voltage E_T as I_L. The analysis which follows assumes a load of linear characteristics, so that load resistance

$$R_L = \frac{E_T}{I_L}$$

In order for the VR tube to operate within its rated limitations, three relations must be satisfied by the circuit values shown in Fig. 1.

First, the voltage applied to the VR tube in its unfired condition must equal or exceed the minimum supply voltage E_F for the particular tube type. Since the tube itself

Table I—Electrical Characteristics of VR Tubes

Tube Type	OA2	OA3 VR75	OB2	OB3	OC3 VR105	OD3 VR150
D-C Operating Volts.....E_T	150	75	108	90	105	150
Min D-C Supply Volts.....E_F	185	105	133	130	133	185
Max Tube Current (amps).....$I_{T\max}$	0.030	0.040	0.030	0.030	0.040	0.040
Min Tube Current (amps).....$I_{T\min}$	0.005	0.005	0.005	0.005	0.005	0.005

represents essentially an infinite resistance before it fires, the minimum supply voltage requirement may be expressed as

$$E_s \frac{R_L}{R_L + R_s} \geq E_F$$

Load resistance may be expressed in terms of the load voltage E_T and maximum load current I_{Lmax} which exist when the VR tube is fired. The expression may then be solved for required supply voltage E_s, for example, yielding

$$E_s \geq E_F + \frac{E_F}{E_T} R_s I_{Lmax} \qquad (1)$$

Once the tube has fired, the minimum VR tube current must equal or exceed I_{Tmin} for the tube type employed. The tube will draw its lowest value of current when the load current is maximum. At maximum load current, the circuit relations for Fig. 1 are

$$E_s = E_T + R_s (I_T + I_{Lmax})$$

Since the VR tube current must equal or exceed the minimum value I_{Tmin}, the required supply voltage is then limited by the equation

$$E_s \geq E_T + R_s (I_{Tmin} + I_{Lmax}) \qquad (2)$$

Equations 1 and 2 both relate to the maximum load current and both must be satisfied in order for the VR tube to operate within the proper limits.

The third condition of VR tube operation which must be satisfied is that the tube current must not exceed I_{Tmax}. For this condition, it is possible to write another expression similar to Eq. 2 but for minimum load current and maximum tube current. This expression is

$$E_s \leq E_T + R_s (I_{Tmax} + I_{Lmin}) \qquad (3)$$

Once a VR tube type has been selected, the circuit values chosen must be such as to satisfy Eq. 1, 2 and 3 simultaneously.

The charts of Fig. 2 through 4 present Eq. 1, 2 and 3 in a form which is convenient for the design of VR tube circuits. Once a tube type has been selected, known or assumed values of any two of the quantities supply voltage, supply series resistance, and load current permit determination of the third quantity.

Each of the figures shows supply voltage as the ordinate, supply series resistance as the abscissa and load current as a parameter. The maximum load current which may be drawn without exceeding the VR tube ratings is indicated by a family of solid lines, while minimum load current is presented by dashed lines. The charts may be entered at the ordinate, abscissa or parameter and followed to a point which represents a suitable combination of all three variables (four considering both maximum and minimum load currents).

Use of the charts in designing VR-tube regulated supplies is best illustrated by the following examples:

Example 1. Using an OA2 with a supply voltage of 300 volts and a supply series resistance of 5,000 ohms, what is the maximum load current which may be drawn?

Solution: Find the point on the OA2 chart, Fig. 2, corresponding to 300 volts and 5,000 ohms and interpolate between the solid lines. The maximum load current is found to be approximately 19 ma.

Example 2. In example 1, what is the minimum permissible load current?

Solution: The zero-ma minimum load-current line passes through the point representing 300 volts and 5,000 ohms. Hence the load current may be allowed to fall to zero.

Example 3. What is the lowest value of supply voltage which may be used with an OA3 voltage regulator to supply an output of 75 volts at any load current between 5 and 20 ma? What value of series resistance is required?

Solution: Using the chart for the OA3, Fig. 3, the minimum permissible value of supply voltage will be found at the point where the line representing a maximum load current of 20 ma intersects the line representing a minimum load of 5 ma. This point is found to be at 152 volts and the required series resistance is 1,700 ohms.

Example 4. In example 3, what

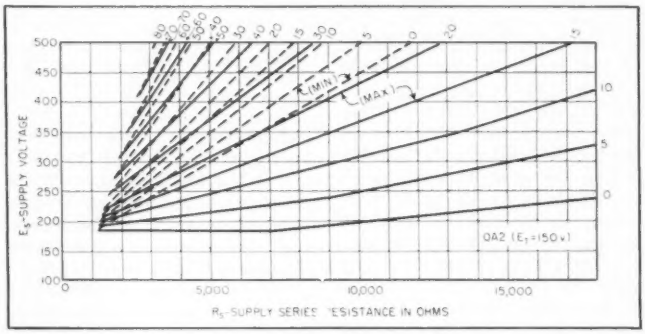

FIG. 2—Family of curves for the OA2

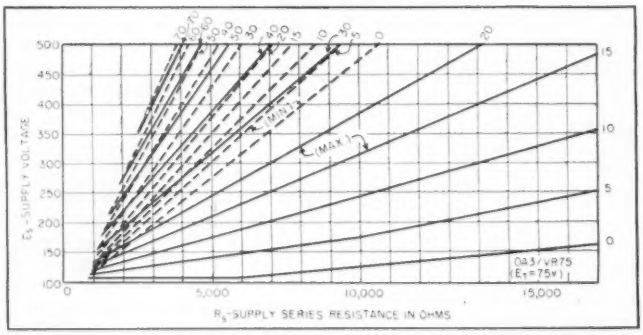

FIG. 3—Family of curves for the OA3

is the lowest nominal value of supply voltage which may be used if this voltage is subject to a ± 5-percent variation? What is the new value of required series resistance?

Solution: This problem may be solved readily by a trial and error method as follows. The variation in supply voltage necessitates a nominal supply voltage higher than that found in example 3. From example 3, one may first assume a minimum supply voltage of 152 volts together with a series resistance of 1,700 ohms. The corresponding nominal supply voltage is 152/0.95 = 160 volts. At minimum supply voltage, concern is with maximum load current. From example 3, the maximum load current is known to be 20 ma for 152 volts and 1,700 ohms. The value of maximum supply voltage is 160 × 1.05 = 168 volts. From Fig. 3, however, it will be seen that this voltage and a series resistance of 1,700 ohms correspond to a minimum load current of 15 ma instead of the desired 5 ma. Consequently, these values may not be used.

As a second assumption, one may choose a higher value of supply series resistance, 3,000 ohms. With this value, a maximum load current of 20 ma can be delivered with a minimum supply voltage of 188 volts. The corresponding nominal supply voltage is 188/0.95 = 198 volts and the maximum supply voltage is then 198 × 1.05 = 208 volts. With 208 volts and 3,000 ohms, minimum load current is slightly less than 5 ma. Thus a nominal supply voltage of 198 volts and a series resistance of 3,000 ohms will be adequate.

Example 5. In examples 3 and 4, what supply voltage and series resistance will be required if the supply-voltage variation is ± 10 percent from nominal?

Solution: By the same method used in example 4, the required nominal supply voltage is found to be 268 volts (241 volts minimum to 295 volts maximum). The required series resistance is 4,900 ohms. Examples 3, 4 and 5 illustrate the severe penalty in terms of supply-voltage requirements and power loss imposed by a varying supply voltage.

Example 6. Using an OB2 tube in a circuit with a fixed supply voltage of 350 volts, what range of adjustment must be provided in the series resistance in order that any load current from 0 to 50 ma may be supplied?

Solution: The maximum series resistance required is determined by the zero-ma minimum load current and is found from Fig. 4 to be 8,100 ohms. The minimum series resistance is determined by the 50-ma maximum load current and is 3,550 ohms.

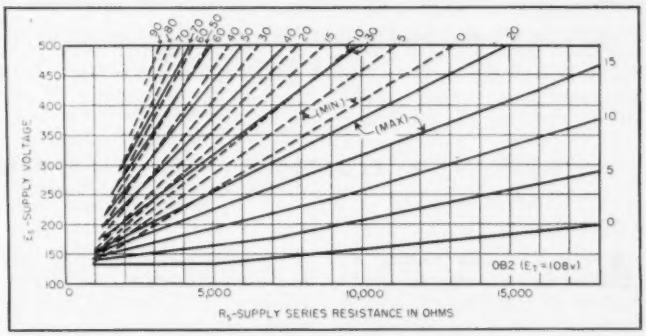

FIG. 4—Family of curves for the OB2

Example 7. What nominal supply voltage and series resistance should be used to deliver 108 volts at a constant load current of 20 ma from a supply using an OB2 if supply voltage is subject to a ± 5-percent variation and if a ± 10-percent tolerance resistor is to be used as the series resistance?

Solution: This problem is solved by a process of trial and error. First assume a minimum supply voltage of 157 volts and a minimum series resistance of 1,000 ohms (values at the intersection of the two 20-ma load-current lines on the OB2 chart, Fig. 4). Maximum supply voltage is then $\frac{157\times1.05}{0.95}$ = 173.5 volts and maximum series resistance is $\frac{1,000\times1.1}{0.9}$ = 1,220 ohms.

At 157 volts and 1,220 ohms, maximum load current is only 15 ma. Also, at 173.5 volts and 1,220 ohms the required load current is not available. As a second set of assumptions, choose a minimum supply voltage of 220 volts and a minimum series resistance of 2,900 ohms. Corresponding maximum values are 244 volts and 3,540 ohms. Examination of Fig. 4 discloses that, with any combination of these values of maximum and minimum voltages and resistances, minimum load current is less than or equal to 20 ma and maximum load current is greater than or equal to 20 ma. Therefore, the corresponding nominal values of voltage and resistance, 232 volts and 3,220 ohms, will be satisfactory.

Example 8. Two type OA2 tubes in series are to be used to supply 300 volts regulated at 10 to 15 ma load current. What supply voltage and series resistance should be used?

Solution: Using the OA2 chart, Fig. 2, find the supply voltage and resistance required to deliver the specified load current at 150 volts from a single tube. These values are 213 volts and 1,600 ohms as determined from the intersection of the 15-ma maximum and 10-ma minimum load current lines. These values may be doubled to find the required values for 300 volts from two tubes. Required voltage and resistance are then 426 volts and 3,200 ohms, respectively.

Similar sets of curves may be drawn for other VR tube types and the curves of Fig. 2, 3 and 4 may be extended to include higher supply voltages.

Bandwidth of Quarter-Wave Sections

Charts show relative bandwidth obtained for specified impedance ratio and reflection coefficient when a load is matched to a transmission line by a single or double quarter-wave matching section. Band for the double section is half again as wide as that for a single section

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A WIDELY used method for matching the impedance of a load to a transmission line is to interpose a short line between the two. The characteristic impedance of this matching section is made the geometric mean of the impedance of the load and the transmission line; its length is made a quarter wave at the frequency for which the impedances are to be matched.

In general, however, the load is required to be matched over a band of frequencies. If the load need not be perfectly matched, the bandwidth over which the load is matched within a specified reflection coefficient can then be computed from transmission-line equations. It is more useful, however, to normalize the equations and to plot their solutions as design curves[1]. This has been done in the charts whose uses are described.

The first chart is for a single quarter-wave section; the second chart is for a double quarter-wave section. The double section matches the impedances—for a specified maximum reflection coefficient—over a wider band than the single section. By comparing the bandwidths on the two charts for a specified problem, it can be determined quickly whether a single or a double matching section is required.

Consider first the commonest type of matching section—a line that is a quarter-wavelength long at the matching frequency f_1. For maximum bandwidth (and perfect matching at f_1), the load must be a pure resistance at f_1.

If the load is a pure resistance R, constant with frequency, the reflection coefficient $|K|$ can be calculated and plotted as a function of the relative frequency f/f_1 for various values of relative load R/R_0 where R_0 is the characteristic (resistive) impedance of the transmission line. This was done in Fig. 1, giving the frequency characteristic for a series of values of R/R_0. Because the chart is symmetrical about $f/f_1 = 1$, it has been folded back on itself about this axis. Then, if $|K|$ is required to be less than a certain value, the maximum and minimum values of f/f_1 are given at that ordinate. The following is a ty-

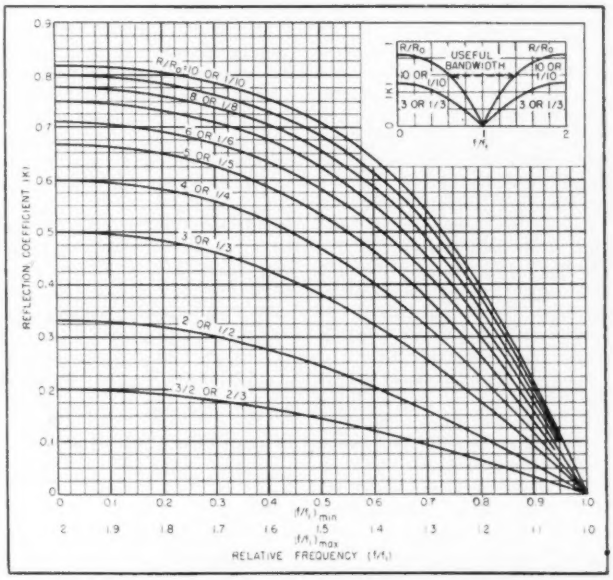


FIG. 1—Frequency characteristic of a quarter-wave matching section

pical example: Given a resistance of 140 ohms to be matched to a 70-ohm line, $R/R_0 = 2$, and the frequency characteristic is given by this curve in Fig. 1. If $|K|$ is required to be less than 0.2, the limiting values of f/f_1 are about 0.61 and 1.39; the frequency band is 1.39/0.61 or 2.28 to 1.

Folding the chart about $f/f_1 = 1$ results in the relative frequencies being spaced as in an arithmetic series. Because the edge and center frequencies used in specifying bandwidth are usually in geometric ratio, $f/f_1 = 1$ is not the center frequency as usually given. Rather, in the foregoing example, the relative center frequency (the geometric mean between the edge frequencies) is $f/f_1 = 0.92$.

Double Quarter-Wave Section

The simplest multiple-matching section is a pair of lines of equal length, each a quarter-wavelength long at the matching frequency f_1. At this frequency the load must be a pure resistance R for perfect matching. For this case and by proper choice of the impedances of the matching sections, a purely resistive load can be transformed at f_1 to an impedance that not only has the correct resistance (with zero reactance) but also has a zero derivative of resistance (and of reactance). Thus the whole frequency characteristic can be improved, giving a considerably wider frequency band than that obtained by the single, conventional quarter-wave section.

For the case of a constant resistive load, Fig. 2 gives the relative bandwidth. The reflection coefficient $|K|$ was calculated and plotted as a function of relative frequency f/f_1 for various values of the relative load R/R_0. The curves of this chart are very similar to those of Fig. 1, except that the frequency band for a specified $|K|$ is wider.

For example, using the values of the previous problem (140-ohm load matched to a 70-ohm line with $|K|$ less than 0.2), from the curve in Fig. 2 for $R/R_0 = 2$, the limiting values of f/f_1 are found to be about 0.45 and 1.55; the frequency band is 3.44 to 1. Thus, the band for the double section is half again as wide as that for a single section.

It will be noted, of course, that the curves for single and double-matching sections come to the same values of $|K|$ at $f/f_1 = 0, 2, 4$ and so on.

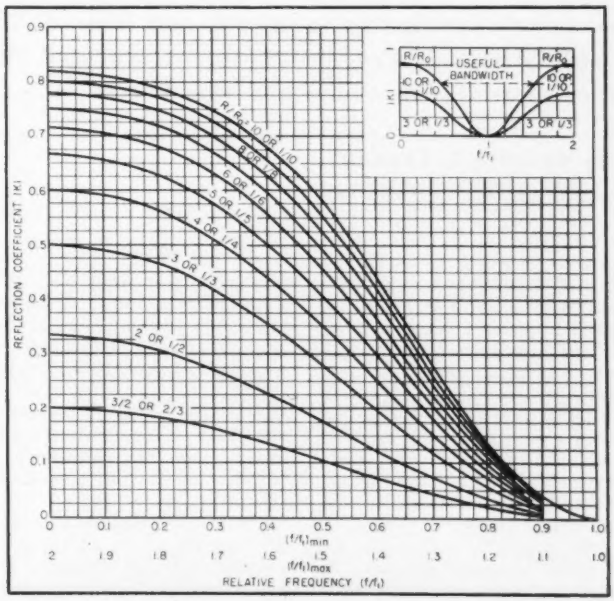


FIG. 2—Frequency characteristic of a double quarter-wave section

Impedance Computations

In using the information obtained from the two charts, one computes the required characteristic impedance for the matching sections. For a single matching section of impedance Z, the impedance is given by $Z = (RR_0)^{1/2}$. For a double-matching section where the section nearer the load has an impedance Z_1 and the section nearer the line has an impedance Z_2, the impedances of the sections are given by

$$Z_1 = \sqrt{R(R_0R)^{1/2}}$$

$$Z_2 = \sqrt{R_0(R_0R)^{1/2}}$$

The charts are plotted in terms of reflection coefficient $|K|$. Impedance ratios are often measured in terms of standing-wave ratios S. The relation between the two is

$$|K| = (S - 1)/(S + 1)$$

Figures 1 and 2 are plots of $|K|$ as functions of transformation ratio $A^2 = R/R_0$ and the relative angular frequency $\Theta = 0.5\pi f/f_1$. The equation for Fig. 1 is

$$|K|^2 = \frac{|A^2 - 1|^2}{(A^2 - 1)^2 + 4A^2 \sec^2\Theta}$$

The equation for Fig. 2 is

$$|K|^2 = \frac{|A^2 - 1|^2}{(A^2 - 1)^2 + 4A^4 \sec^4\Theta}$$

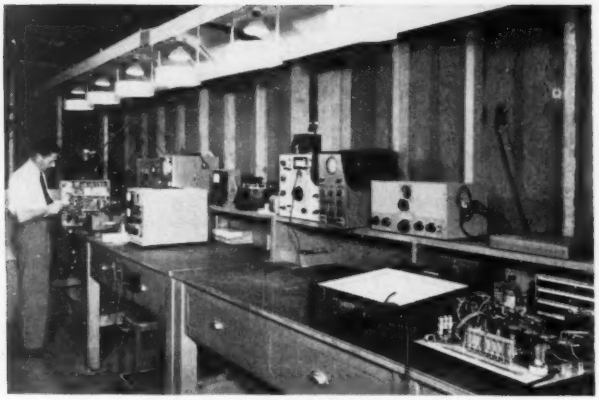
If the load impedance is a resistance that varies with frequency, the charts are no longer valid.

The charts given here can be used in several ways other than that illustrated in the examples. If the maximum tolerable reflection coefficient and impedance ratio are specified, the charts show whether a single or a double matching section can produce a match, and, if so, what bandwidths can be obtained.

If the relative bandwidth and either the reflection coefficient or the relative impedance are specified, the unspecified quantity can be determined. Thus, these charts provide useful design data for many common transmission-line problems.

Reference

(1) E. G. Fubini, P. J. Sutro and R. F. Lewis, Frequency Characteristics of Wide-Band Matching Sections, Report 41123, Radio Research Laboratory, Harvard University, April 19, 1943.



"A shielded or screened inner room is desirable for noise-free receiver alignment and transmitter testing"

Servicing Mobile Radio Equipment

New business opportunity combining some attributes of the engineering consultant with those of the radio serviceman exists in the rapidly growing two-way radio field. At the present rate of expansion, more qualified technicians and inexpensive test equipment will be needed to keep communications systems running at top efficiency

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SKILLED radio technicians throughout the United States and Canada are finding new opportunities to expand existing servicing business by adding facilities for mobile communications equipment.

Up to May 1949, two-way mobile radio communications facilities for police and other emergency services, developed over the past 20 years, were generally serviced in shops maintained by municipalities or companies operating large fleets of mobile units.

In the past three years, since the Federal Communications Commission has released its stabilized mobile communications plan, thousands of new radio systems have been established by progressive taxi operators, oil companies, lumbering interests, trucking and transportation concerns, ambulance services, common carriers with their fleets of private subscribers, small municipalities, industrial services and numerous others.

This rapidly expanding use of electronic equipment is beginning to present many maintenance problems for owners and operators. In many cases, the equipment was originally installed by the manufacturer's sales engineering organization. Because the federal law requires that a licensed technician be responsible for the equipment, some inexperienced person in the company with a license or a local radio repairman, has often been assigned the task of keeping the system operating.

In many instances a local broadcast station technician with limited test equipment is attempting to assist several small radio communication systems in his area.

For economic reasons the small operator of a dozen taxis, or three ambulances, a utility with 15 mobile units, or a small community with a dozen police cars and two fire engines, must seek outside technical assistance from a skilled technician holding at least a second-class radiotelephone license.

A number of qualified technical men have seen the opportunity of establishing a profitable business in this growing field. A review of their operations will indicate that most of them start out with their own back-yard service shop or small radio repair shop. In many cases these men are licensed amateur radio operators with transmitter experience or a good technical knowledge of f-m radio equipment and circuits.

They put themselves through a training program on the various types of communications equipment which they will have to maintain. These servicemen have found the equipment manufacturers interested in helping them do a good job. Most manufacturers will gladly furnish service manuals, circuits and a wealth of technical data to qualified servicemen. A number of the larger equipment manufacturers will send a representative to inspect the shop, make recommendations for proper test procedures on their equipment, suggestions for test equipment needed, or even establish the shop as an authorized service station for specific sets.

The service technician desiring to enter this equipment maintenance field must possess a second-class radiotelephone license, or better yet, a first-class license.

Opportunity Knocks

A manufacturer writes, "There are excellent servicing opportunities in the mobile communications field for qualified technicians. It is a growing field with little competition offered to the man who has above-average technical know-how. Because of the inherent complexity of communications equipment, the qualifications are in excess of those required for routine service of home sets."

Such a serviceman is ultimately responsible to the Federal Communications Commission both for the accuracy of required tests and for subsequent operational performance. Moreover, the usefulness of mobile equipment may often depend in large part upon the availability of qualified service personnel.

The design of simple, inexpensive electronic test equipment, some of it to solve problems unique to this field, offers still another opportunity

Test Equipment

Most of the test equipment found in a modern radio shop can also be used for servicing mobile f-m radio equipment. This would include a modern tube tester, oscilloscope, vacuum-tube voltmeter, a good all-purpose volt-ohm-milliammeter, and possibly a sweep generator.

Special test equipment that is not usually found in radio and television service shops but should be included in the f-m communication equipment service shop would include:

Some form of grid-dip meter for circuit alignment, and r-f output wattmeter (also used as a dummy antenna load), a precision all-band oscillator with controlled output (crystals with reference points on all intermediate frequencies), and a number of small test items that the technician can build.

These items should include a single-tube Pierce oscillator with plate current and output indicators for testing quartz crystals, a small amplifier with impedance multimatching input transformer for testing microphones, and a field-strength meter to cover all of the communication frequencies.

The FCC requires that operators of mobile and base stations in the communication services must have each licensed transmitter checked for frequency deviation, modulation, and power input at least every six months. This service should also be offered by the progressive communications service shop.

Many service technicians have purchased secondary frequency standards (such as BC-221 and LM) from war surplus sources, altered the equipment to cover the frequency ranges of interest to their clients and built or purchased interpolation oscillators for expanded applications. The surplus type TS-323 covers the 20 to 200-mc range. Commercial frequency standards are also available.

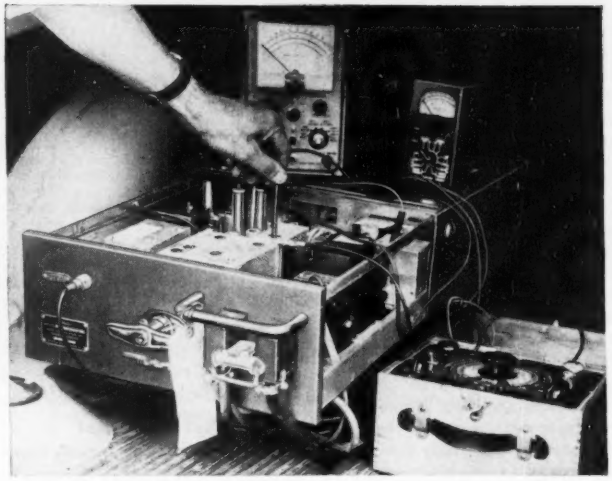
Radio station WWV is the primary source of calibration check and its service is available to anyone merely by tuning in the standard frequency transmissions on 2.5, 5, 10, 15, 20, 25, 30 and 35 mc. By utilizing the heterodyne principle and beating the WWV signal against a local secondary standard, continuous accurate calibration can be maintained. Local broadcast stations (required to maintain frequency within ±20 cycles) and their harmonics offer additional check points.

The modulation meter for a-m systems may be an oscilloscope or

"Many of the servicemen in the Southern California area maintain a portable service shop in a panel delivery truck . . ."

inexpensive modulation indicator meter. For frequency modulation checks the deviation instrument is not so simple. It is possible to build and calibrate an instrument using accurate crystal-controlled receivers with the addition of calibrated deviation indicators in the discriminator circuits. This equipment would have to be checked for frequency and placed exactly on the transmitter frequency before each measurement.

Commercial modulation measuring equipment is available and would probably be less expensive than a composite modulation-deviation indicating instrument. Some of the mobile equipment manufacturers make an all-purpose test kit for their equipment which is very satisfactory for tuning purposes.



"Most manufacturers will furnish service manuals, circuits and a wealth of technical data to qualified servicemen"

Charges

Simple mobile equipment installations can be done in a day's time by one man with some additional assistance on larger installations. Trucks, fire engines, and special vehicles usually take more time, owing to the need for waterproof housing boxes and other special construction. No standard exists for installation or service charges, but new mobile installations usually run about $25.00 and up.

Main-station installations, antenna erections and control-desk wiring should generally be done on a labor plus materials basis.

Some fleet operators are paying from $3 to $10 per month per mobile unit for maintenance labor plus parts. This charge includes routine repairs and service checks, six months complete frequency, modulation and power-input measurements, and technical supervision of the system. Main station equipment maintenance contracts run slightly higher.

Most small operations prefer to pay a straight labor-plus-parts cost when the equipment fails, or at the six-months service period.

Preventive maintenance is hard to sell the small operator. The large operator has found that it reduces the possibility of equipment failure with resulting increased in-service time.

The well-organized service shop should include some provision for working on cars within a building, preferably over a pit, hoist, jacks, or ramp. The necessity for working under the cars to install cables makes some form of car-elevating device desirable.

The service bench should have a 7.1-volt 60-ampere direct current source available from busbars extending to all service positions. Storage batteries with a floating charger will supply this current, but a high-current transformer, dry-disk rectifier and large filter make for a cleaner operation. A high-current ammeter and an accurate 0-to-8 volt d-c voltmeter are useful features in this bus supply system.

Screen Room

A shielded or screened inner room is desirable for noise-free receiver alignment and transmitter testing.

Soldering irons of the instant-heat type or with very small tips are necessary to work within the limited clearances of most modern mobile equipment.

Other tools required should include rubber and forceps-type tube-pullers, soldering-aid tools, tube-pin straighteners, long-nose pliers, diagonals with sharp oblique points, miscellaneous pliers, wrenches, socket sets and screwdrivers. A good stock of spare parts including tubes, vibrators, all values of resistors and capacitors, filters, generator brushes and wire should be maintained.

Portable Shop

Many of the servicemen in the Southern California area maintain a portable service shop in a panel delivery truck or station wagon. This practice permits them to make the rounds of their many customers, working a day or two at each location.

One of the most useful service procedures in the larger systems is the maintenance of one or more spare units for instant exchange in the field or when the car driver comes to the main shop with a defective unit. This provision permits repair work on the service bench under ideal conditions and it does not hold up a busy customer while the serviceman looks for a defective component.

Automobile Electrical System

Prior to tuning up a new installation in a radio car the battery voltage should be checked. Most radio equipment manufacturers recommend a battery voltage of not over 7.2 volts and not under 6.3 volts measured at the battery terminals. There is a voltage drop in the long battery cables to the larger

"Preventive maintenance . . . reduces equipment failure with resulting increased in-service time"

mobile equipment particularly during the time the transmitter is in operation. Special high-current generators or alternators with dry-disk rectifiers are recommended for cars with mobile radio equipment of the 30 and 60-watt sizes.

Care in adjusting the car's voltage regulator will usually permit continued use of the standard (35 amp) car generator for mobile units up to and including 30 watts if the battery is not required to furnish power for too many other loads such as red lights, sirens, heaters, fan and full lights for considerable night driving.

Standard automobile voltage regulators are seldom set for optimum adjustment at the factory and considerable trouble from too-low or too-high battery voltage is common. This fact necessitates drilling off enclosure rivets, and with accurate d-c meters, adjusting the charging rate to maintain a 7.2-volt value under normal driving conditions.

The battery's specific gravity should be approximately 1.280 when a regulator is adjusted. Drivers should be cautioned to inspect battery water level at least once a week. Battery voltage should be checked as part of the routine equipment service.

Ignition noise reduction should be accomplished on all initial installations. Resistor-type spark plugs may be necessary. Capacitors, suppressors, and full instructions are usually furnished with the installation kit that comes with a new mobile unit.

Ignition noise in some cars presents problems that can best be solved by reading all the known data on the subject and then overcoming individual cases by trial and error. Experience will be the best guide on noise elimination as each car is different with respect to ignition-noise problems.

Legal Tips

One of the most important goodwill building services that a mobile service station can render its customers is to help educate the owners and operators of the radio equipment.

Field engineers of the FCC indicate that a large number of law violations by mobile fleet operators result from not understanding the simple rules and regulations about keeping an operating log, posting licenses, announcement of call letters, and dozens of other simple requirements that most engineers and all licensed operators must know.

The best sources of legal information are the following government bulletins:

Part 6—Rules Governing Public Radio Communication Services, 10¢.
Part 10—Rules Governing Public Safety Radio Services, 10¢.
Part 11—Rules Governing Industrial Radio Services, 10¢.
Part 13—Rules Governing Commercial Radio Operators, 5¢.
Part 16—Rules Governing Land Transportation Radio Services, 10¢.

These publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

By studying the legal requirements and passing the information along, the serviceman helps the customers operate within the law. Six-month service checks should also include a check of operating practices to be sure the customer is operating in such a manner that embarrassing violation citations will not be received each time his system is inspected by a field representative of the Federal Communications Commission.

A good shop file system is indispensable. Accurate technical logs are required on each piece of equipment serviced. Copies of this information should also be on file at the customer's headquarters for reference at inspection time. Service file records should also show expiration dates of customers' construction permits and station licenses. At least two months notice should be given them prior to expiration or better yet, they should be assisted with their license problems.

Identification tags issued by the Federal Communications Commission must be attached to each mobile transmitter.

By offering this type of courtesy to customers, assuming a few routine responsibilities for them, and doing a good workmanlike technical maintenance job, it will soon be found either that the shop will have to turn new business away or expand to accommodate a rapidly growing, profitable organization.

Some of the photos used in this article were furnished through the courtesy of the Southern Counties Gas Co. of California and the Los Angeles County Flood Control District.

High-Power

Front panel has six-position frequency-duration switch

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IN THE STUDY of vacuum-tube cathodes[1], a pulse generator supplying square-top high-voltage and high-current output pulses was desired.

Previous experiments with vacuum-tube cathodes had shown correlation between the emission of a cathode when operating with direct current and with short duration pulses.

Pulse Technique

If pulses of relatively long duration were used, it was hoped that the correlation between direct current and pulsed emission data might be improved to a point that would permit the pulse technique to be used. This would allow the measurement of temperature-limited emission without excessive heating of tube parts.

For this work a pulse generator was required capable of supplying pulses with a maximum amplitude of 1,200 volts at two amperes of current drain with approximately a one-percent duty cycle. Both pulse amplitude and repetition rate were required to be adjustable. A survey of existing commercially available pulse generators revealed none capable of supplying pulses with the required peak power and voltage amplitude. To satisfy these requirements, the pulse-generating circuit shown in Fig. 1 was developed. Although specifically designed for a study of vacuum-tube cathodes, this instrument may find other applications where nearly square-top, high-voltage and high-current pulses are desired.

It was essential for this application that overshoot of pulse amplitude, at the beginning and end of the pulse, be minimized. The need for multiple power supplies and transformers with high-voltage insulation was to be eliminated if possible.

The use of standard components or easily constructed special components was a primary aim in the instrument design.

Circuit Description

The complete circuit diagram of the instrument is given in Fig. 1. An unbalanced multivibrator, V_1, is controlled to give repetition rates of 10, 20, 30, 40, 50 and 60 pulses per second, with a constant one-percent duty cycle. The six-position selector switch S_1 provides the selection of pulse repetition rate and at the same time adjusts the pulse duration so that the one-percent

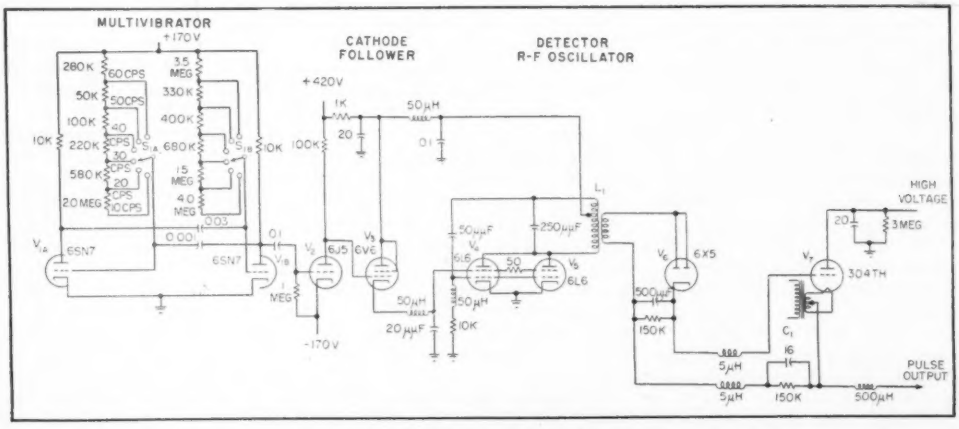

FIG. 1—Schematic diagram of the pulse generator

Square-Pulse Generator

Repetition frequency is variable in steps from 10 to 60 pulses per second with fixed duty cycle of one percent. Output is square-top pulses at several amperes with adjustable amplitude up to 1,200 volts

duty cycle is maintained. The multivibrator output pulses are amplified by a single triode stage V_2 and coupled by the cathode follower V_3 to the r-f oscillator V_4 and V_5 which is then keyed-on for the duration of the pulse.

The cathode follower controls the screen voltage of the class-C 4.2-mc oscillator, holding it biased at cutoff until a positive pulse is received. The oscillator output is a 4.2-mc carrier with 100 percent 10 to 60-cycle modulation. This triggered oscillator and rectifier combination is substituted for a pulse transformer with high-voltage insulation, which otherwise would be required for such applications.

Diode Detector

The signal is applied to a diode detector from the secondary winding of the oscillator coil L_1. This secondary is used in place of a transformer and high-voltage insulation between the two windings of L_1 provides the necessary isolation from the high d-c output voltages.

The modulated signal is passed through a diode detector V_6 resulting in a square-top pulse of the same repetition rate and duty cycle as that of the multivibrator. This pulse is then used to trigger the 304TH power triode V_7 supplying the desired output pulse.

Grid current in V_7 provides bias fairly independent of plate-supply voltage, thus the tube is self-biased to cutoff with the −130 v charge on C_1. The plate voltage of the 304TH is supplied from an adjustable external source not exceeding 2,000 volts, control of which determines the output pulse amplitude. Both the r-f oscillator and detector are enclosed in a shielded box to keep the radiated energy to a minimum.

All circuit components are commercially available with the exception of the oscillator coil L_1 the construction details of which are given in Fig. 2.

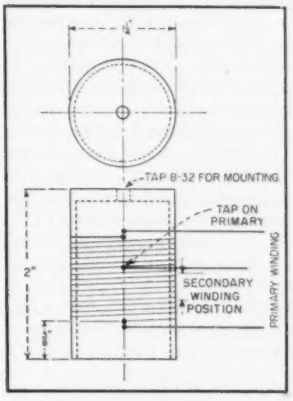

FIG. 2—Construction details of the oscillator coil

Performance

The instrument produces square-wave pulses at a repetition rate of 10, 20, 30, 40, 50 and 60 pulses per second with a duty cycle of one percent, equivalent to pulse durations from 165 to 1,000 microseconds.

The pulse amplitude is determined by the plate voltage of the 304TH triode V_7. In the service for which the instrument was designed, pulses at voltages up to 1,200 volts with 2-ampere current drain were obtained.

With the use of other external power supplies, to supply the high plate voltage of the 304TH, pulses at higher voltages and considerable higher currents may be obtained.

The output pulse has an amplitude which was found to fall off linearly at the rate of 0.01 percent per microsecond of pulse duration. The drop, for example, is two percent for 200-microsecond pulses. This die-away is due primarily to the decrease in the plate supply voltage for the 304TH, resulting from discharge of the final capacitor in the supply. The circuit is capable of supplying pulses having sufficiently flat tops to meet the requirements of many applications calling for square-top, high-voltage and high-current pulses.

Coil Construction

A drawing showing the construction details of the coil form for oscillator coil L_1 is given in Fig. 2. The primary consists of 16 turns of No. 20 copper wire with Formex insulation, with a tap six turns from one end, wound 12 turns per inch. The secondary is composed of 10 turns of No. 20 copper wire closewound over the primary as shown. Insulation between primary and secondary must be capable of withstanding 2,000 volts.

The author is indebted to M. L. Greenough for many helpful discussions and suggestions.

REFERENCE

(1) Ralph Forman and G. F. Rouse, Oxide Cathode Base Metal Studies, *NBS Journal Research*, 46, p 30, Jan. 1951.

Frame Synchronization

Analysis shows present FCC monochrome sync waveform contains adequate timing information for reliable frame synchronization on simple triggered basis for use with NTSC color-television system. Simple circuit is developed and discussed

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PROPOSED NTSC Standards for compatible color television are based on the principle of adding color to a monochrome picture by means of a color subcarrier. The standards include the technique of color phase alternation wherein the phase sequence of colors in the color subcarrier is reversed on alternate fields. The red color difference signal leads the blue color difference signal by 90 deg during one field and lags by 90 deg in the succeeding field in each frame, and results in improved color fidelity.

An arrangement for automatically synchronizing the direction of reversal at the receiver and at the transmitter is essential. This necessity has created the problem of determining whether or not adequate timing information exists in the present monochrome FCC synchronizing waveform to provide reliable frame synchronization for color television.

Apparently there is enough timing information in the present signal for this purpose.

Frame synchronization, as described in this paper, depends on a beatnote process and requires the combination of two pieces of timing or synchronizing information, one at field rate and one at line rate.

Timing information at any single frequency may exist within a composite sync waveform in three basic forms; it may exist as a single component at the fundamental sync frequency, it may be carried by harmonics of the fundamental frequency, or it may exist in the beatnote between two signal components which are not harmonics of the fundamental sync frequency. The problem of using all of the timing information at any frequency involves using all of the frequency components which may help carry the desired timing information and decoding it so that it is converted to the desired frequency in the most efficient manner with regard to signal-to-noise ratio.

Figure 1 shows ideally how the line and field timing information can be combined for frame synchronization. The line rate information derived from the composite sync signal is used in the form of very narrow pulses which are shown at the correct normal phase during each field retrace period. The field rate information derived from the composite sync signal is used in the form of a single broad pulse during each field retrace period, having, ideally, a duration of just a little less than one line. In field 1 the field pulse normally occurs halfway between two line pulses. In field 2 the field pulse is coincident with one line pulse and provides a means for positive means of identification of this field.

In actual practice the waveforms used may differ from these ideal waveforms. More important, the presence of random noise causes fluctuations in the relative timing between the line and field rate pulses. It is possible to obtain substantially perfect performance down to some level of signal-to-noise ratio at which the random fluctuations become large enough so that occasional observable errors in identification of the fields occur. In order to evaluate the level at which this begins to take place in (color phase alternation) frame synchronization, for bandwidth-limited white thermal noise, it is necessary to understand the physical nature of sync timing information.

Basic Timing

For any sync signal $S(t)$ such as that shown in Fig. 2, there is an upper limit to the sync accuracy, which can be computed for any specified signal-to-noise ratio. Since the signal is repetitive, it can be expressed in terms of a Fourier series. The signal is characterized by its peak-to-peak amplitude S_o, by phase coefficient ϕ_k and by the relative amplitude coefficients Z_k. The relative phases of the frequency components do not affect the sync accuracy which can be obtained, provided these phases are

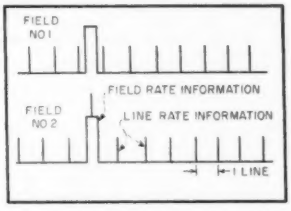


FIG. 1—Idealized drawing shows how line and field timing information can be combined for frame synchronization

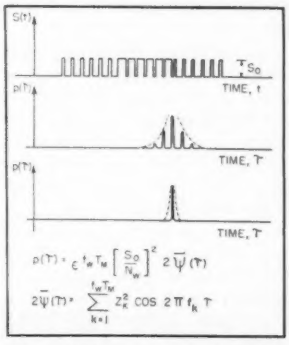


FIG. 2—Typical sync signal analysis used to study basic timing information

for Color Television

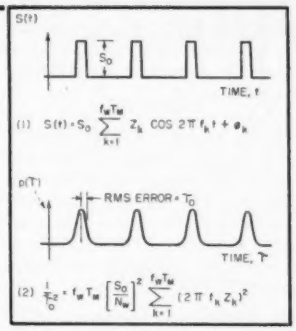


FIG. 3—Field timing signal which is applicable for frame synchronization

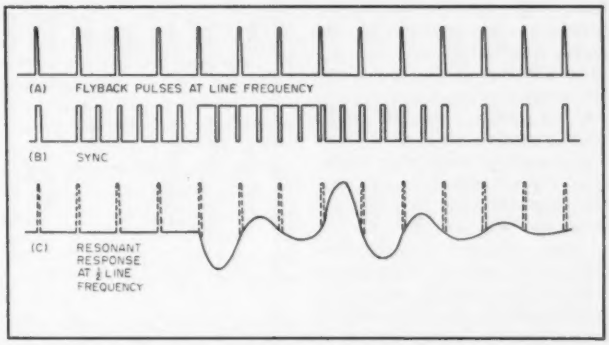


FIG. 4—Waveforms showing one mode of time-selection relating to field I, as explained in text

known in advance.

The measuring device may be considered to examine a section of the signal, T_M in duration, for each composite measurement of the sync signal. Each such measurement defines the phase during a cycle. If the video signal bandwidth is f_w there are $f_w T_M$ possible harmonic components associated with each time measurement of the signal. If the noise is uniform throughout the band f_w it may be represented by its rms value N_w.

The timing accuracy obtainable for a given signal-to-noise ratio may be expressed in terms of a relative probability density function $p(\tau)$ such as appears in Fig. 2. The curve $p(\tau)$ permits the determination of the probability that the sync timing answer which results from a single complete measurement of the sync signal will occur within a specified time interval. This probability is proportional to the area under the curve $p(\tau)$ within the specified interval.

The curve $p(\tau)$ defines the probability laws for the noise in the output of the synchronizing system. The probability curve which describes the timing accuracy is repetitive at the fundamental frequency of sync because the sync signal is repetitive. In other words, the output noise from the sync measuring device has the same character from cycle to cycle.

For many energy distributions, $p(\tau)$ has very nearly the shape of a normal or gaussian probability curve, and in such cases it may be completely specified by the rms time error of measurements τ_0 for any specified signal-to-noise ratio. When the normal law applies, as it may for line or for subcarrier phase synchronization, the formula shown in Fig. 2 may be used to compute the rms time error. The formula shows that the mean squared error is inversely proportional to the product of several quantities. These are the number of independent Fourier component phase measurements applicable to each time measurement $f_w T_M$, the power ratio of signal-to-noise during a sync pulse $(S_o/N_w)^2$, and a function which depends on the distribution of signal energy throughout the frequency spectrum. This formula is based on taking the best possible weighted average of the timing measurements on all of the frequency components of the signal. This formula applies accurately when there is enough timing information in the low frequency components to identify cycles of the highs. For example, it is found that line-frequency flyback pulses in a receiver having an efficient afc system with a reasonable time constant of integration may be considered essentially noise free for purposes of frame sync performance, at all noise levels for which the video content of the picture is likely to be visually acceptable.

Timing Threshold

The field timing signal which is applicable for frame synchronization is indicated as $S(t)$ in Fig. 3 for one field sync interval of a frame. When the signal-to-noise ratio is very poor, the relative probability density function for time measurements, $p(\tau)$, has the serrated shape shown by the upper curve of Fig. 3. This occurs because there is not enough low-frequency timing information, indicated by the dotted curve, to identify completely one of the multiple peaks. At some higher signal-to-noise ratio, as indicated in the lower curves for $p(\tau)$, the main lobe is effectively the only one that exists and the formula presented earlier for the rms error may apply.

Whenever the probability density curve is multipeaked, the rms error based on the characteristics of the main lobe is not adequate to describe the threshold accuracy and it is desirable to know the shape of the probability density curve. The equation for $p(\tau)$ which is shown in Fig. 3 has been used to estimate the threshold of substantially perfect performance for frame sync. It includes as exponential parameters the number of independent phases or harmonic components $f_w T_w$, the

power ratio of signal-to-noise during a pulse peak, and a function which is represented by a series including all of the Fourier components of the signal, weighted according to the squares of the relative amplitudes.

The function $\psi(\tau)$, is a form of normalized auto-correlation function. In many cases its value for a specific value of τ may be computed by convolution methods. The threshold level has been computed from this formula for the case where the first pair of side lobes of the multipeaked probability density curve is 10 napiers or 87 db smaller than the main lobe. It corresponds to slightly more than one erroneously phased field in a 15-minute program. For this case the rms noise is approximately five times the peak-to-peak amplitude of the sync pulses.

This value obtained for the complete composite field sync signal including the notches and equalizing pulses is only two db better than would be obtained for a single broad pulse three lines in duration, using the same formula. This occurs as a result of the nonuniform energy distribution of the signal, which causes the high-frequency components introduced by the equalizing pulses and notches to be chiefly effective to quantize $p(\tau)$ as shown, but not to narrow its envelope substantially.

This suggests that if a beatnote type of frame sync system is built in which horizontal flyback timing information is compared with the basic field synchronizing information of the broad pulse group, and the information added by the equalizing pulses and notches is ignored, that it should be possible to obtain substantially perfect performance up to the point where the rms noise is about four times as large as the peak-to-peak amplitude of sync pulses.

Waveforms, Field 1

One method which has been used to accomplish nearly this level of performance is as follows. The field selection is made by comparing the phase of vertical field synchronizing information with the phase of horizontal flyback information. The composite sync waveform is used to shock-excite a damped tuned circuit resonant at one-half line-frequency. The resulting waveform exists predominantly in response to the field synchronizing broad pulses. When keyed during horizontal flyback intervals, this oscillation permits selection of the desired field as on alternate fields the line rate keying pulses occur alternately (1) at the intervals of zero amplitude or (2) the intervals of peak amplitude of the damped oscillation at one-half line-frequency.

Figure 4 presents some waveforms illustrative of this mode of time selection relating to field 1. Curve A represents flyback pulses at line frequency. Curve B represents the sync signal near the field sync interval. Curve C represents the resonant response at one-half line frequency, the peaks of which may be seen to be interleaved in time between the line flyback pulses.

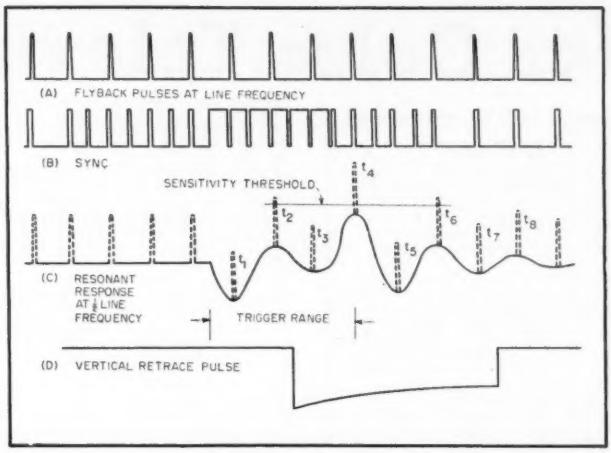


FIG. 5—Field 2 waveforms show coincidence of flyback pulses and peaks of ringing waveform

Waveforms, Field 2

Figure 5 represents relevant waveforms occurring in field 2. Curve A represents flyback pulses at line frequency and curve B represents the sync signal near the field sync region. Curve C represents the resonant response at one-half line frequency. In this case the flyback pulses are coincident with the peaks of the ringing waveform. A peak detector will nominally select the pulse at t_4. If the sensitivity threshold is adjusted as indicated, any one of the pulses at t_2, t_4 and t_6 may be used to identify the start of the selected field in the frame. The unit which derives an output pulse from the combined timing information, so that the desired field in each frame may be identified, is called a field recognizer.

Although the line rate pulses are present at all times the resonant ringing of the one-half line-frequency resonator normally occurs only at the field sync intervals. This self-keying action is adequate for reliable field recognition in the presence of weak signals with substantial thermal noise interference. In the presence of strong impulse noise interference it is desirable to provide additional noise immunity. This immunity may be obtained by time-gating so that the field recognizer is operative only during a short interval in each field in the vicinity of the vertical sync interval.

Curve D represents a pulse indicative of the occurrence of vertical retrace relative to the synchronizing waveform of curve B. Such a pulse normally appears in television receivers across the spike resistor of the interstage network between the vertical scanning oscillator and the vertical output amplifier. The indicated variation in front edge or

trigger range is believed representative. The retrace pulse provides a convenient source of a narrow time gate for impulse noise immunity. A pulse duration of the order of five lines is reasonable. This means that the system can be made to ignore noise impulses 98 percent of the time.

Circuitry

The connections of a typical cpa frame synchronizing system in a color television receiver are shown in the block diagram of Fig. 6. The frame sync system receives as input signals composite stripped sync from the sync separator of the receiver, horizontal flyback pulses from the horizontal scanning system and vertical retrace pulses from the vertical scanning system. It provides a square-wave control voltage as an output to the color decoder of the receiver.

A detailed block diagram showing the units in the frame sync circuit is shown in Fig. 7. The cpa frame sync system includes a field recognizer unit and a square-wave generator or flip-flop. The field recognizer unit is shown within a dashed line box. It includes a sync amplifier and limiter and associated circuitry, a shock-excited resonant circuit tuned to one-half line frequency, an amplitude limiter for the 60-pps field keying pulses which gate on the recognizer and the recognizer phase detector which is a biased peak detector.

Output of the recognizer phase detector is normally a train of pulses at a 30-cycle rate occurring, for example, at the normal trigger time t_n. Occasionally, ringing of the one-half line-frequency resonator by impulse noise will cause an output pulse from the recognizer phase detector on the undesired field. Less often a desired sync pulse may be missing. The 30-cps output pulses from the recognizer are fed to the flip-flop for providing triggering in one direction. A 60-cps train of pulses derived from the leading edge of the vertical keying pulse by differentiation is fed to the flip-flop for triggering in the other direction.

The circuit arrangement is such that after the flip-flop has been triggered it cannot be triggered again during the keying interval. In this mode of operation, called latch-on, once the flip-flop has begun operating in the proper phase sequence, occasional noise output pulses from the recognizer on undesired fields are not able to interfere with the proper functioning and the phase sequence of the flip-flop or of the cpa switching system. This reduces the time interval in each frame during which the noise impulses can cause interference from two to one percent. Since noise causes extra output pulses from the recognizer more often than it causes the desired pulse to be missing, the reduction in the number of erroneous phases due to severe impulse noise is greater than two or one.

A schematic diagram for the frame sync circuit is shown in Fig. 8. An input signal of about 15 volts of positive composite sync is supplied as indicated to the sync amplifier through a wave-shaping network which is designed to emphasize the trailing edge of the vertical broad pulse group. For best performance, it is desirable that the sync be double limited prior to this point. The resonant waveform is developed across the tuned transformer. Horizontal flyback pulses derived from the horizontal scanning system are added in series with it, by virture of L_2. The resultant waveform as it appears on alternate fields at the grid of the recognizer phase detector is sketched in the figure. The 60-cycle vertical retrace pulses are applied through the pulse limiter tube, and a biasing network, to the cathode of the recognizer phase detector, to render it sensitive during the pulses. The plate current of the phase detector is a series of pulses at a 30-cycle rate and is fed to a suitable point in one voltage divider of the flip-flop. The 60-cycle pulses derived from the leading edges of these field retrace pulses are fed capacitively to the other voltage divider of the flip-flop which then generates a synchronized 30-cycle square wave as indicated in the figure.

Waveforms relating to the mode

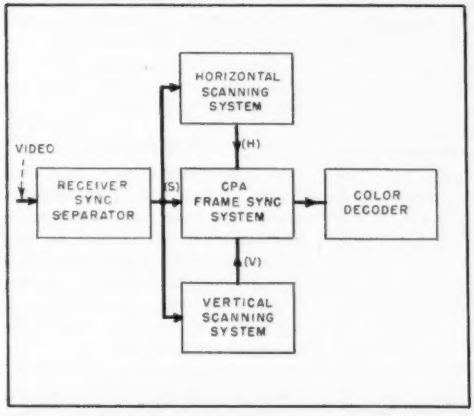


FIG. 6—Block diagram shows connections of frame sync system in tv receiver

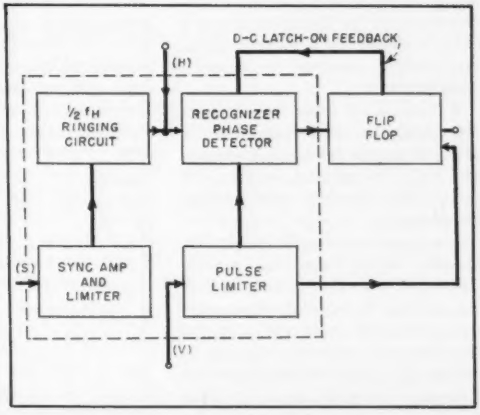


FIG. 7—Frame sync circuit consists of field recognizer (inside dashed line) and flip-flop circuit

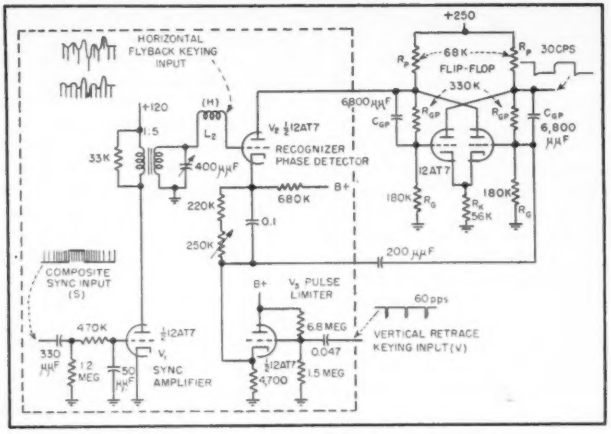


FIG. 8—Schematic for frame synchronization system

of triggering are shown in Fig. 9. Figure 9A represents (to an exaggerated time scale) the negative keying pulses at field rate, as they appear at the cathode of the recognizer phase detector V_6. Figure 9B represents the differentiated pulses derived therefrom for triggering the flip-flop in one direction. Figure 9C represents the output current pulses of the recognizer phase detector V_6. Pulses P_1 and P_2 represent normal output pulses in the desired fields. Pulse N_1 represents a spurious pulse due to noise in an undesired field. Figure 9D represents the desensitized period for the system following field trigger pulse F_1, whereby N_1 is ignored. Figure 9E shows the grid waveform of the flip-flop showing the existence of a finite recovery time after triggering, thereby causing the desensitized periods.

Experimental tests were run to investigate the performance of the field recognizer for normal signals, and under the adverse conditions of weak, noisy signals and impulse interference.

An important factor relating to impulse noise immunity of the frame sync system is the ability of the receiver to maintain horizontal and vertical synchronization in the presence of impulse interference, as well as the ability of the receiver to maintain a good signal-to-noise ratio at the output of the sync channel in the presence of noise.

The circuit was tested in several different receivers, having different sync systems. All of these receivers provided double-limited full amplitude sync at the output of the sync channel for all signal levels of interest.

For thermal noise, the threshold level with this circuit appears to be within a few db of the theoretical optimum value for a triggered system. In most cases when misfirings occurred, the cpa phase was in error for one sixtieth of a second. This disturbance has low visibility due to its short duration, and it was masked by the high amplitudes of the low-frequency components of thermal noise in the video signal at the levels for which occasional misfirings would occur. Visibility of the short time (1/60 second) misphasing of cpa sync was higher in some present models of color receivers than it will be in true constant luminance receivers.

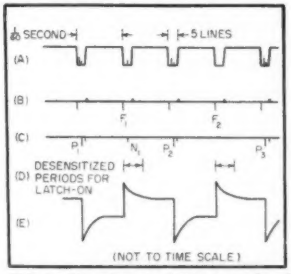


FIG. 9—Waveforms relative to mode of triggering flip-flop

One difficult problem in the evaluation of thermal noise performance is the determination of the noise level at which the picture becomes visually unacceptable. This level may vary by a considerable amount, depending on a number of factors. Tests thus far, as viewed by one group of observers, have indicated that the video signal may become visually unacceptable due to noise in the picture before occasional misphasing of the cpa frame sync occurs.

In the presence of high-amplitude impulse noise the frame sync appeared to hold together to within a few db of the level at which vertical sync failed, in all receivers. The differential performance of field versus frame sync did not appear to vary significantly between receivers.

The tests indicated that the timegate for impulse noise immunity provides the difference between satisfactory and unsatisfactory performance with impulse interference.

Field tests now in progress should provide more data on how well triggered frame sync meets the requirements. While it is recognized that the effective signal-to-noise ratio can be further improved by integration, using an afc system, data obtained thus far does not indicate this as being necessary.

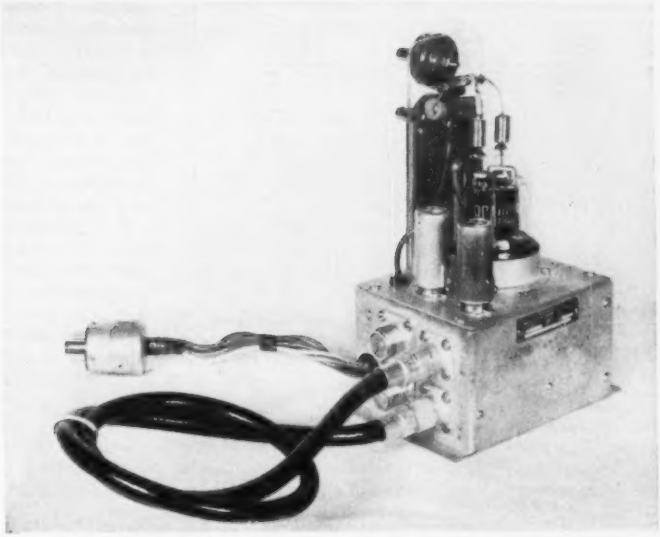
Preliminary field tests for adjacent and cochannel interference using color receivers designed for the NTSC signal shows that pictures usually become intolerable in video content before cpa sync fails.

The circuit presented above is economical and thus far has given satisfactory performance.

Conclusion

It has been shown that the present monochrome FCC synchronizing waveform appears to contain adequate timing information for reliable frame synchronization on a simple triggered basis, and that simple circuits can be built which achieve close to the theoretical optimum performance.

The author is indebted to J. R. White, R. J. Keogh, C. E. Page and C. J. Hirsch for encouragement in the preparation of this paper.



Chassis of cathode-ray-tube beam intensifier showing delay cable used to control duration of beam-on time

Cathode-Ray-Tube Beam Intensifier

Three-tube circuit provides positive spot intensification for millimicrosecond oscillography of random transients. Composite photographs of high-voltage pulses may be made using intensifier to select various portions of pulse

By ROBERT W. ROCHELLE

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SPECIAL TECHNIQUES are employed in the design of intensifiers for use with multiband post-acceleration cathode-ray tubes. These tubes are noted for their extremely high writing speed and spot brilliancy. The duration of the signal presented to them is small, so that advantage can be taken of their fast writing rate. Intensification of the beam becomes harder to accomplish as the period of observation grows smaller. To offset this, a cathode-ray-tube intensifier has been developed to provide positive intensification for time durations in the millimicrosecond range. This intensifier originally was designed to intensify the beam from nonrecurrent transients. The prime requisite is that the transient signal be delayed as little as possible while the tube beam is being turned on.

There are various methods of intensifying the beam of a cathode-ray tube. Multivibrators often are used to gate long-time-base oscilloscopes. As observation time is shortened, the multivibrator cannot be depended upon to produce the desired rise-time gating pulse; consequently, some systems use thyratrons. Thyratrons have fast ignition time; however, with low triggering voltages, ignition time may be well over one microsecond. This time is too long for observation of fast rise-time pulses. Further, ignition time of a thyratron varies with trigger-signal waveform and amplitude. The intensifier described uses a hard tube as the gating tube and thyratrons to shut off the beam.

This system is novel in that the

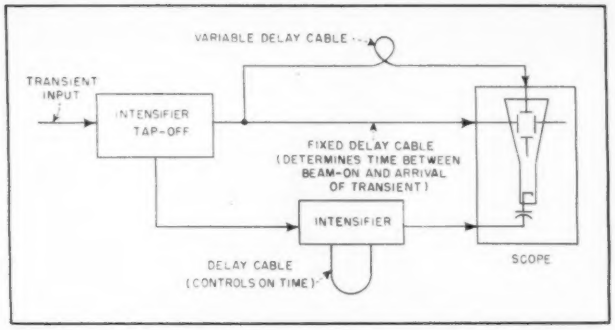

FIG. 1—Block diagram shows how intensifier is connected with oscilloscope

gating signal is the trigger signal amplified and clipped. The hard tube assumes two functions: it amplifies a portion of the leading edge of the trigger signal and clips the remainder to provide a constant level of intensification. Clipping occurs in the grid circuit as the grid goes positive. The output is a negative signal and must be capacitively-coupled to the cathode of the cathode-ray tube.

Since multiband high-voltage cathode-ray tubes have deflection factors in the range of 100 to 250 volts per inch, the signal applied to the plates can be applied directly to the intensifier through a tap-off. This results in extremely accurate time coordination between gating pulse and observed signal.

With negative or zero trigger signals the intensifier is turned off. It is on only for positive signals that carry the hard tube to zero grid bias. This is not a disadvantage since the purpose of this type of intensifier is to examine a small portion of a pulse, such as the leading or trailing edge. Various portions of the pulse may be displayed by changing the length of delay cable between the intensifier tap-off and the cathode-ray tube. A series of pictures of the pulse taken with decreasing length of delay line will effectively expand the sweep length many times when the pictures are joined to make one composite photograph.

Linear Sweep

The generation of a linear sweep for a short duration presents a difficult problem. A convenient method of generating a linear sweep, when observing such phenomena as rise times of phototubes and pulse generators, is to bias the cathode-ray-tube horizontal plates so that the linear portion of the fast rise from the signal appears across the center of the tube. The vertical signal may then be delayed in successive steps by inserting lengths of delay line to complete the composite photograph. Figure 1 is a block diagram of the setup.

The intensifier delays are adjusted so that intensification is obtained only in the linear portion of the horizontal trace. When this method is used, there will be no time jitter between the signal and the sweep. An advantage in the case of periodic signals is that a sweep generator is not required for the oscilloscope. Periodic signals are handled in the intensifier by removing the thyratrons. Biasing the grid of the hard tube controls the duration of intensification, and the delay line from tap-off to intensifier controls the phase.

The circuit of the intensifier is given in Fig. 2. A 3E29 or 829-B is used as the hard tube. The ability of these tubes to deliver a large current at zero grid voltage helps to charge the cathode-ray-tube cathode capacitance quickly, resulting in a faster rise time. The series grid resistor allows clipping to occur after the trigger signal has reached zero grid bias and, consequently, has been amplified in the plate circuit.

Two 2D21 thyratrons turn off the intensifier. One is across the screen grid of the 3E29 and the

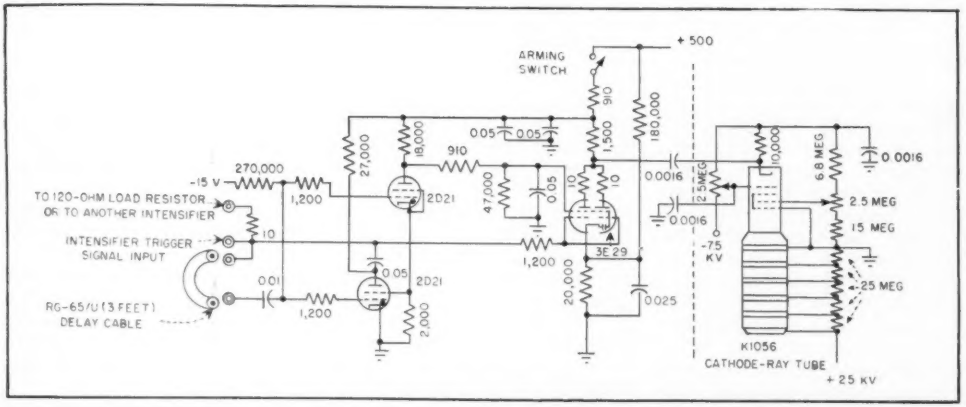

FIG. 2—Complete circuit of intensifier attached to multiband postacceleration cathode-ray tube

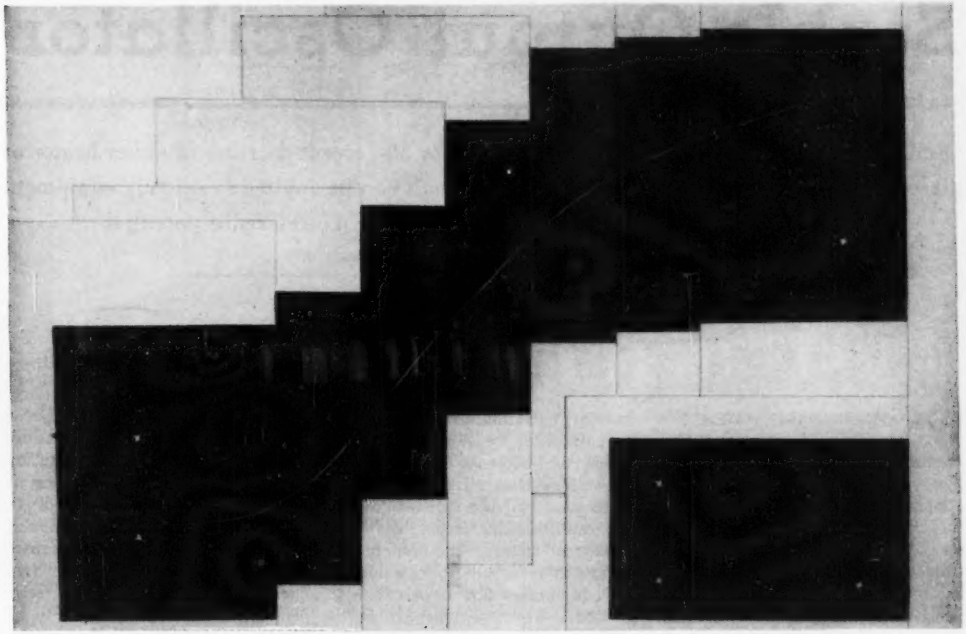

FIG. 3—Composite photograph of pulse rise made with intensifier. Time scale is a 6,500-mc sine wave

other is across the control grid.

For the particular application for which the intensifier was designed, it was necessary to lock out all signals after the main signal. The thyratrons are triggered from the main trigger signal but delayed for the presentation time by means of a small section of high-delay RG-65/U cable. This cable has a characteristic impedance of 950 ohms and a velocity of propagation of approximately 20 feet per microsecond. The screen-grid thyratron provides positive lockout, but its action is not fast enough. The screen-grid capacitor is slow in discharging; therefore, a thyratron has been added on the control grid to provide immediate cutoff. However, this thyratron will not lock out for all time owing to the possibility that a negative trigger signal could extinguish the tube by carrying its plate below ground potential. Another positive signal would then intensify the hard tube before the trigger signal reached the thyratron grid through the high-delay cable, thus causing a spurious intensification. This cannot occur since the screen-grid thyratron has cut off the hard tube.

The intensifier has been used to intensify a DuMont type-K1056 multiband, high-writing-speed cathode-ray tube. The time of signal observation can be changed by connecting different lengths of RG-65/U delay cable on the side of the intensifier. A 2-ft length gives approximately 100 millimicroseconds of presentation.

Transient Photography

Figure 3 shows a composite photograph taken of the leading edge of the output from a pulse generator. The linear-rise portion of the pulse comprises the horizontal sweep as explained above. The pulse was connected to the vertical plates through a delay cable. A delay of four millimicroseconds was added in this variable delay cable after each picture was taken, until the entire leading edge had been photographed. Fiducial markers from small masked lights near the cathode-ray-tube screen aided in positioning the individual photographs.

A timing trace for obtaining a time base was made by photographing a 6,500-mc magnetron output on the vertical plate against this same horizontal sweep. A distance equivalent to four millimicroseconds, the time delay between successive photographs, was laid off in the center of the negative. This distance was transferred to the pulse photographs, and the right edge of each was clipped at the end of the 4-millimicrosecond period. The traces were then joined and photographed, as shown in Fig. 3. The resulting trace covers a total time of 30 millimicroseconds.

By using the method just described, the resolution will effectively be increased when large signals are to be observed. Another advantage is that the recording is obtained with a minimum of required equipment; for example, it is not necessary to employ a pulse attenuator or to provide a horizontal sweep source.

The author wishes to acknowledge the helpful suggestions rendered by H. J. Peake and N. W. Matthews in the design and development of this intensifier.

Stable-Output Oscillator

Oscillator amplitude is reduced only 3 percent for 30-percent decrease in either heater or plate-to-cathode potential. Output stabilizing circuit can be applied to existing equipment when provided with 2-ma source of regulated d-c reference potential

By SHERWIN RUBIN

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MODERN INSTRUMENTATION has increased the demand for stable radio-frequency potentials. For widest application, generators supplying such voltage should satisfy certain requirements. First, r-f output amplitude should be maintained within reasonable limits over an anticipated range of long and short-term variations. Second, means for varying the magnitude of the regulated potential should be included, and third, circuits should remain simple and noncritical from the standpoints of maintenance, adjustment, and economics.

Regulated amplitude oscillators satisfying one or more of the above requirements, either in full or in part, have been constructed.[1,2,3] The main advantage of the unit to be described here is its ability to operate with any positive d-c reference potential available, whether within or external to the equipment of which it is a part. To the author's knowledge, the particular circuitry shown has not been previously used in this manner. From the standpoints of economics, simplicity, and ease of adaptability to existing equipment, the above feature should prove valuable for laboratory use.

The input stage of the d-c amplifier, upon which control depends, and the voltage divider that supplies the reference potential comprise V_3, R_4, R_5 and R_6 in the circuit diagram. It is this circuit feature that makes the unit so readily adaptable in practice. The fact that the plate resistor of the input stage of the d-c amplifier V_3 is 15 megohms limits the maximum cathode current variation to less than 20 microamperes, when using a supply potential of 300 volts or less. With the voltage-divider resistors R_5 and R_6 chosen to allow a current flow of two milliamperes from the d-c reference source, the maximum change in reference voltage due to cathode current flow is less than 1 percent.

The output of oscillator V_1 is rectified by a CK-707 germanium diode, and the positive d-c potential thus obtained is applied to the grid of V_2. The d-c amplifier output stage V_3 is a cathode follower that supplies the plate and screen power to the oscillator. An increase in potential at the grid of V_3 causes a decrease in potential at the cathode of V_3, thereby reducing the amplitude of the r-f output of V_1. The stabilizer thus attempts to keep the r-f output amplitude constant.

Circuit Analysis

Voltage-divider network R_5 and R_6 allows adjustment of output amplitude. For many purposes a particular output voltage is desired. In these cases R_5 can be fixed and minor adjustments for a constant-output voltage made by detuning the oscillator tank capacitor, C_1. It might be preferable to obtain the reference potential from a gaseous regulator tube or a stabilized low-voltage supply using a mercury cell battery as reference.[4] For this reason, the values of R_5 and R_6 are not specified.

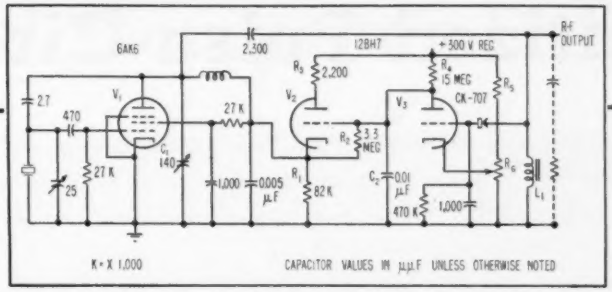
The rectifier circuit is a series, peak-reading arrangement. A 2-mh iron-core choke L_1 provides a low-resistance d-c return necessary for capacitively coupled peak-reading rectifiers. The choke in question must have sufficient reactance at the lowest oscillator frequency to minimize oscillator loading, and hence must not become series resonant at the highest oscillator frequency. In the circuit shown, rectification efficiency was found to be constant within 2 percent in the range from 1.8 to 19.5 megacycles.

In the V_3-to-V_2 coupling network, C_3 (a plate bypass capacitor) prevents the unit from oscillating as a low-frequency phase-shift oscillator. The plate of V_3 is directly coupled to the grid of V_2. Resistor R_{g2}, connected from the grid to cathode, provides the grid return for V_2. The impedance looking into the grid of V_3 is

$$Z = R_3\left(1 + \frac{\mu R_1'}{r_p + R_1'}\right) + \frac{r_p R_1'}{r_p + R_1'}$$

For this equation, only the low-frequency case has been considered; R_1' is the parallel impedance of R_1 (the cathode-follower cathode resistor) and the plate and screen-loading of V_1; μ is the amplification factor of V_2. When R_3 is large compared to the parallel combination of R_1' and r_p, the second term on the right may be neglected.

Under the operating conditions for the circuit shown, the plate resistance of V_2 is approximately 4,000 ohms and the minimum value of R_1' is about 4,000 ohms. The μ of V_2 is about 20. Under these conditions, the load presented to the plate of V_3 by the input of V_3 will be approximately 36 megohms. It



Circuit diagram of the stabilized oscillator. Control section can be used with existing oscillator circuits to insure constant-amplitude output

should be noted that with this circuit arrangement, some of the current drawn by V_3 will come from the cathode of V_2. This restricts the value of R_2 to a magnitude large enough to prevent the maximum current through V_3 from exceeding 20 microamperes. A higher value of cathode current will adversely affect the stability of the reference potential at the cathode of V_2. The cathode resistor R_1 is chosen small enough to keep the cathode-heater potential within rated value if oscillator current discontinues for any reason, but large enough to prevent excess current drain with high output voltages.

Under normal conditions the largest current drawn by this resistor will be less than 2.5 milliamperes. Keeping down the current drawn by the cathode resistor allows the d-c amplifier portion to operate with essentially full gain when the cathode emission falls off (as approximated in tests by reduced heater temperature). Stability with respect to heater potentional changes is thereby improved. The plate resistor R_3 of V_2, is inserted for decoupling and overload protection.

The plate and screen of the oscillator are fed from the cathode of V_2. A d-c blocking capacitor is often connected in series with the tank capacitor of series-fed circuits to prevent temporary shorts in the tank capacitor, during adjustment or operation, from blowing the plate supply fuse. The connection shown eliminates the need for such a capacitor and,in addition, provides a single oscillator d-c power lead.

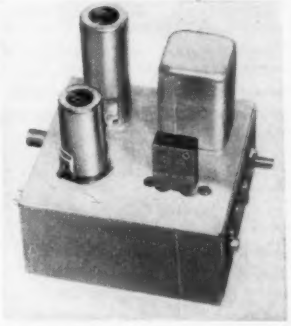
Amplitude-stabilized devices used in a laboratory should be stable with respect both to short and long-time intervals. The prime factors usually affecting amplitude in the short term (fifteen minutes or so) are changes in load and changes in line voltage. Factors affecting long-term stability are usually associated with tube transconductance changes. Stability with respect to short-time changes was approximated by changing heater potential on V_1, V_2, and V_3, and oscillator load. A change of 2½ percent in output amplitude resulted from a 30-percent decrease in heater potential.

Stability

A maximum change of 3 percent in output amplitude resulted from either doubling or halving the oscillator load. Stability with respect to long-time changes may be approximated by changing plate potential on all tubes (keeping the reference potential constant by use of a second stabilized supply) and filament potential.

The tube mutual conductance is a function of plate-cathode potential. The effects of decreased emission from an aging cathode can be approximated by reduced heater potential. Here a 30-percent decrease in heater potential and plate-to-cathode potential (each taken separately) resulted in an output amplitude reduction of 3 percent. Since the accuracy of the average laboratory r-f voltmeter is 3 percent, this stability may be considered good.

The stabilized oscillator described may be used as a separate source of r-f potential, or the d-c amplifier stabilizer may be adapted to existing generators. In cases requiring much greater d-c power for the oscillator, a separate power stage and pentode input tube may be used, or the oscillator plate may be supplied separately and the screen alone fed from the regulator. The unit is simple and easy to install. It shows good long and short term stability, and provides a ready means of amplitude adjustment.



Laboratory model of the stabilized-output oscillator

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Unitized Pulse Circuits

Rack-mounted pulse-control circuits perform basic gating, mixing and delay functions to save time and money in design of pulse equipment. Any type of pulse equipment can be set up quickly by interconnecting basic units with coaxial cable

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PULSE CIRCUIT DESIGN is accomplished with a minimum of time, effort and material by use of basic pulse circuit units to generate, control and distribute 0.1-μsec pulses.

Building block units, like the coincidence detector shown in the photograph, perform elementary pulse manipulations such as gating, mixing and delay. These units are mounted in standard 19-inch racks and may be interconnected by coax to set up any desired type of pulse equipment.

The large photograph shows an experimental digital computer using about 500 pulse-control units. This computer has been in operation for over a year.

Basic pulse-control units are listed in the table. Figure 1 is a functional block diagram illustrating how several basic units may be interconnected. The system shown is a four-way pulse distributor wherein pulses applied to the input appear successively at outputs one, two, three and four. Two flip-flop circuits and six coincidence detectors are employed.

Voltage Waveforms

All operations are performed almost entirely by two kinds of voltage waveforms, a half-sine wave having a 0.1-μsec duration, and a two-valued voltage waveform that can be switched in 0.2 μsec, and which can remain at either value for an indefinite period the higher value being ground potential and the lower value between −14 and −30 volts.

Pulse durations other than 0.1 μsec are used mainly in terminal

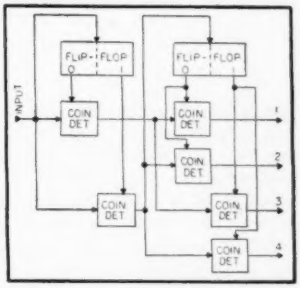


FIG. 1—Four-way pulse distributor requires two flip-flop circuits and six coincidence detectors

circuits linking a system of pulse-control units with other equipment types.

Each unit is designed so that pulse distortion is corrected before the pulse is delivered to the output jack. This correction permits cascading units without pulse deterioration.

Output Characteristics

The pulse-control units deliver 0.1-μsec half-sine pulses into RG-62/U, 93-ohm, terminated coaxial cable. The zero-signal output and baseline voltage level is ground potential.

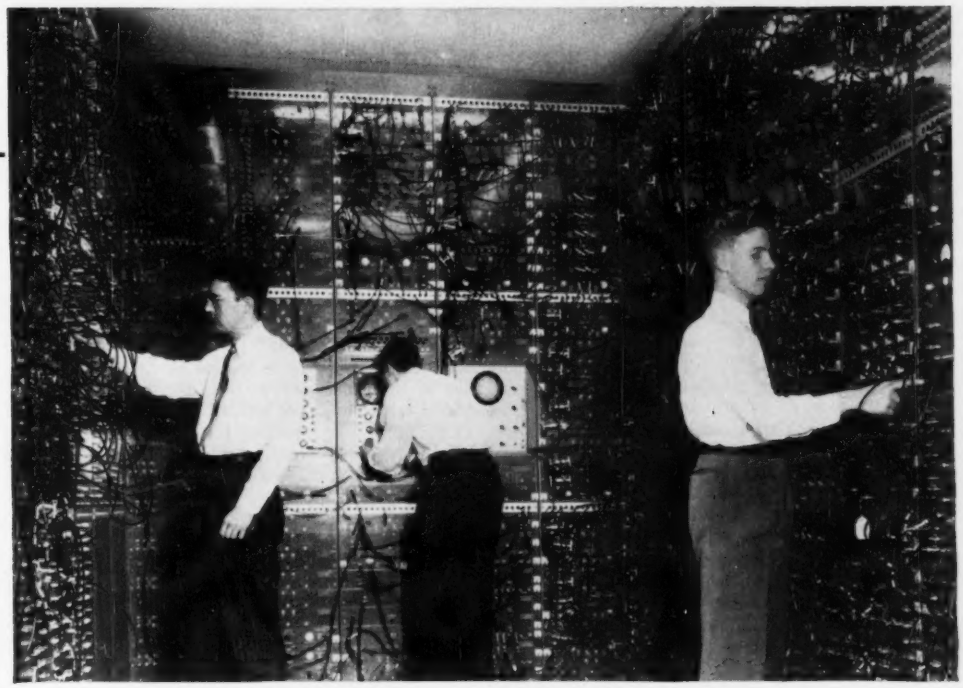
The output transformer is connected to the line through two parallel crystal diodes and a three-position switch. The diodes connect the outputs of several parallel units without impedance mismatch and disconnect the low impedance of the terminated output cable during the time the transformer output tends to go negative. This cuts off negative overshoot and ringing following the output pulse.

The switch permits reversal of output pulse polarity. In neutral position, the transformer is discon-

Building Block Units for Pulse Circuit Research

Unit	Function
Pulse Generator 1001B	Generates 0.1-μsec pulses over continuous frequency range 15 to 650,000 cps
Pulse Generator 1002A	Generates 0.1-μsec pulses over continuous frequency range 0.2 to 4.5 mc
Pulse Generator 1003A	Generates single pulse by push-button control
Flip-Flop 1101B	Bistable E-J circuit can be switched by 0.1-μsec pulses. Two outputs are d-c levels for gating pulses
Coincidence Detector 1201A	Senses coincidence between 0.1-μsec pulse and flip-flop output
Coincidence Detector 1202A	Senses coincidence between outputs of up to five flip-flop circuits
Pulse Delay 1301B	Delays 0.1-μsec pulses from one to 70,000 μsec
Pulse Delay 1302A	Delays 0.1-μsec pulses from 0.1 to 1.9 μsec in 0.05-μsec steps
Channel Selector 1401A	Feeds input 0.1-μsec pulses to four output jacks
Mixer 1601	Mixes up to five inputs for a common output

Speed Computer Design



This experimental digital computer incorporates nearly 500 basic pulse-control units

nected from the output jack.

The output circuits can be paralleled only when the desired pulses have the same polarity.

The amplitude of the output pulse can be varied between 10 and 32 volts by a potentiometer. Output impedance level is not affected by amplitude. The output pulse is slightly distorted at maximum amplitude setting but the distortion will not affect operation of succeeding units.

Input Characteristics

The input circuits utilize positive 0.1-μsec pulses or d-c voltage level. Minimum amplitude required to trigger the units varies from 9 to 15 volts. The units are designed for uniform operation over a wide range of input pulse amplitude.

Since the input impedance of most units is high compared to the characteristic impedance of the terminated cable, it is possible to feed several units with one cable.

When using the pulse-control units with other equipment, it may be necessary to convert the 0.1-μsec pulses into pulses having different shapes and impedance levels. It may also be necessary to convert pulses from an external source into 0.1-μsec pulses.

For these applications, special adapter units must be made to obtain signals with the proper amplitude, shape, impedance and voltage level.

The pulses can be lengthened with single-shot multivibrators, blocking oscillators, smearing circuits, and so on. Pulses from external equipment can be shortened with peaking circuits operated by current pulses easily obtained from single-shot multivibrators, flip-flops, Schmitt circuits, or gas tubes. Gas-tube peaking circuits are simplest, but are limited to lower frequencies.

Coincidence detector is typical of rack-mounted pulse circuit building blocks

Acknowledgment

The author wishes to acknowledge the efforts of Jay W. Forrester, head of Project Whirlwind, MIT, who first proposed the idea of constructing unitized components and whose encouragement led to the development and construction of the original equipment.

Linear Scale

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Phototube timer is located unattended on ski slope. Servomechanism operates meter farther down slope, where skier may stop and read her speed

SKIERS can determine their speeds using a phototube-operated timer that displays speed directly in miles per hour on a linear-scale meter. The timer may be located unattended on the slope with the servocontrolled meter installed at the foot of the hill.

The timer may also be used to clock vehicle and animal speed trials. With some circuit modification, it can measure other events per unit time or events per unit event. Such applications could include measuring cycles per second, watch ticks per hour, revolutions per minute or miles per gallon. If desired, the timer can be modified to display elapsed time as well as speed.

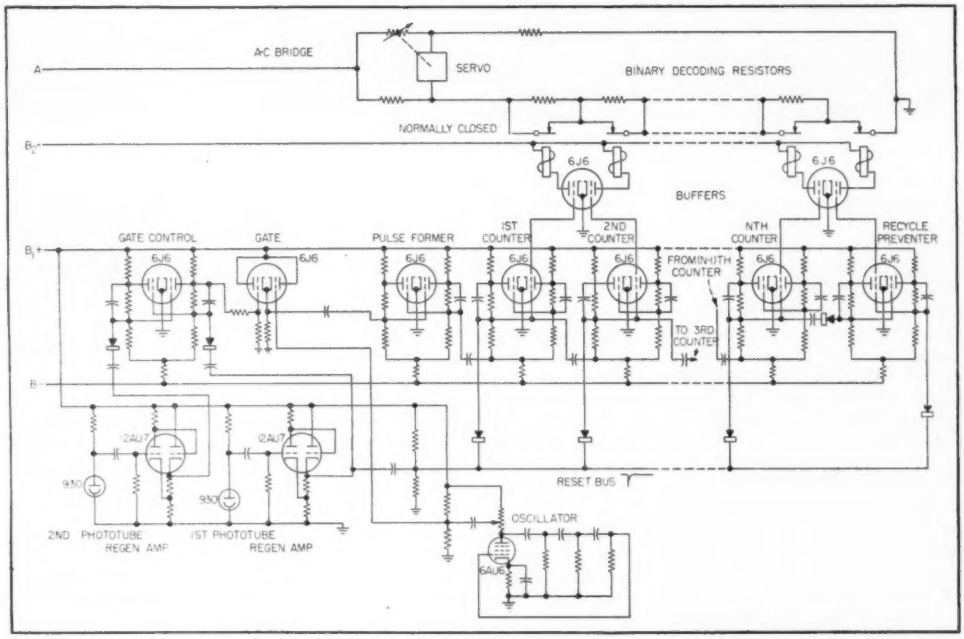


FIG. 1—Phototubes gate pulse input to binary counter. Binary decoding resistors, switched by counter-output relays, form one arm of Wheatstone bridge

Velocity Meter

Versatile timer clocks speed trials, or it can also measure auto miles per gallon. Phototube pair gates constant-rate pulse train fed to binary counter. Counter output selects resistors proportional to elapsed time. Current through resistor chain then varies directly with speed

The device consists of two phototubes separated by a short distance and used to gate a standard oscillator on and off as the skier passes. A binary counter registers the number of cycles passed from the standard oscillator as a measure of elapsed time. Relays operate to connect in series a resistor chain proportional to time and a bridge-balancing servomechanism converts this information into speed.

Circuit Details

Figure 1 is the circuit of the linear, direct-reading velocity meter. The signal from the first phototube is amplified by a regenerative amplifier that accepts the slowly-varying waveform and supplies a pulse to activate the trigger pair that opens the cathode-follower gate. The gate-tube grid receiving the oscillator signal is then at the higher potential and the cathode voltage follows it.

This signal is converted into pulses by a modified trigger pair and the pulses fed to the binary counter until a signal from the second phototube gates off the oscillator signal. The counter stages (bistable multivibrators) activate, with the help of buffer tubes, relays that connect resistors in series. Each successive resistor is twice the previous one. The total resistance is proportional to the number of cycles and thus, to the elapsed time.

If a fixed voltage is applied to this resistance, the current will be inversely proportional to time and an ammeter will give a linear indication of speed. In Fig. 1, the binary resistors constitute one arm of a Wheatstone bridge whose opposite arm is a potentiometer driven to balance the bridge. The setting of the potentiometer is inversely proportional to time and its attached dial can be calibrated in speed.

If a skier feels he has made good time at the measuring point, he can stop farther down the slope and activate the bridge servomechanism to display his speed.

Counter Reset

The trigger pairs act as a short memory, storing information about each skier's speed until the next one comes along. When the next skier passes the first phototube, the binary counters are instantly reset and

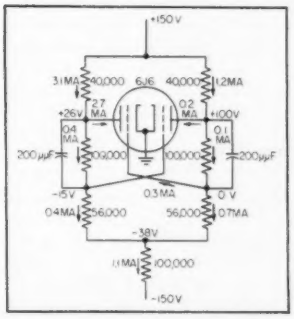


FIG. 2—Binary counter cell capable of counting about 75,000 pulses per second

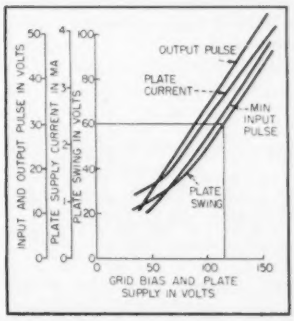
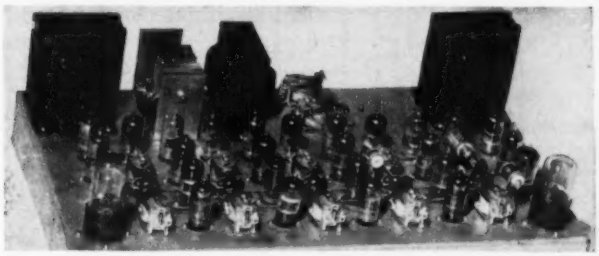


FIG. 3—Characteristics of binary counter cell shown in Fig. 3



Electronic timer using binary counters. Input phototubes are at extreme ends of chassis

immediately start counting.

Reset action is not impaired if, due to a fall, a skier crosses only the first phototube. Since only a limited range of speed is of interest the last trigger pair is diode coupled so it will not switch back. After a maximum count, it opens the resistor string and the reading, if displayed, will correspond to zero velocity.

The cathode-follower gate is especially poor for gating fast, negative-going signals; thus the sinusoidal wave is gated and then shaped into pulses. The reset bus must be biased a few volts positive or the counters will interact and normal counting will be impossible. Circuit constants in Fig. 1 depend upon the order of magnitude of the speeds. A medium-speed trigger pair is shown in Fig. 2. Its characteristics are given in Fig. 3.

These circuits are stable and do not require regulated power supplies. As line voltage increases, output pulse height increases at the same rate that sensitivity of the next stage decreases, and they readily cascade. A convenient operating point is with plate supply and grid bias both approximately equal to 125 v as delivered by half-wave, selenium-rectifier circuits. A switch- operated, monostable multivibrator is used to activate the indicator circuits.

Accuracy

Since the accuracy of indication varies with magnitude, the designer is primarily concerned with maximum error. A maximum error of one percent requires a count of at least 100 cycles during the shortest interval of interest. If a speed range of ten-to-one is to be covered, ten counters are required.

Binary resistors should be accurate to about one percent, though each successive resistor smaller than the seventh need be only half as accurate as the previous one.

If the phototube separation is known, the oscillator frequency (which must be accurate to one percent) is also specified. In practice, however, the oscillator can be adjusted to make all readings perfect once a single known velocity is properly indicated. Although the effective position of a phototube depends upon the gain of the associated amplifier and the speed of passing, both tubes are similarly affected and their separation remains accurately fixed. Parallax introduces little error since the cosine of an angle varies slowly near zero degrees.

Uncertainty in the count can be reduced by using a pulsed oscillator, which can start instantly because its inductive energy is continuously stored, rather than using a gated continuous oscillator.

Light Sources

The device can usually be used with ambient illumination, changes in which have no effect because of the capacitor-coupled input. The heat dissipated by the tubes keeps the windows clear.

In some circumstances, separate light sources are desirable. They can be aimed from inside the phototube housing and the light returned from suitably placed auto-collimators. One can avoid possible blocking by using a U-shaped beam of ultraviolet light falling on a single phototube.

The servomechanism display device is usually preferred to the simpler ammeter. The bridge circuit provides readings independent of line voltage, permits partial cancellation of temperature effects on precision resistors and minimizes possible damage due to accident off-scale operation.

Bridge-Balancing Servo

The servo indicator provides a large, rugged, weatherproof, 360-degree scale and a permanence of display between indications; an expanded scale or suppressed zero may be incorporated.

A simple, bridge-balancing servomechanism is shown in Fig. 4. It employs a differential amplifier to analyze the bridge signal and activate the relays. If there is bridge unbalance, only one relay will be activated. Fitted with trailing-tube rectifiers to stop chattering, the relays operate the motor, which turns to restore bridge balance. If both relays are either activated or not activated, no power is applied to the motor. At such a balance point, no power is drawn and the load is shorted. This not only supplies

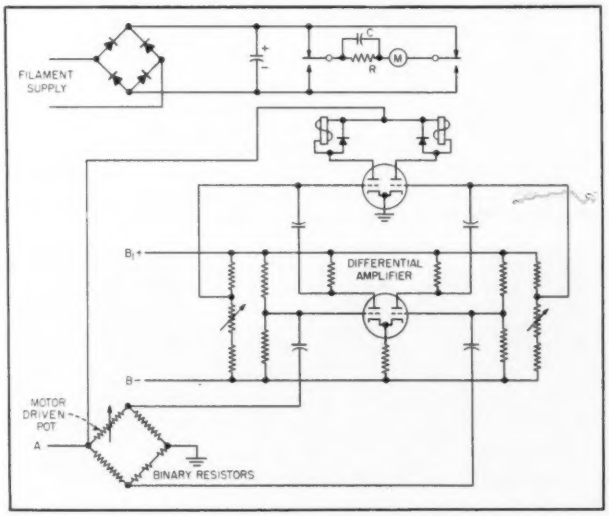


FIG. 4—Bridge-balancing servomechanism employs differential amplifier to control potentiometer motor drive

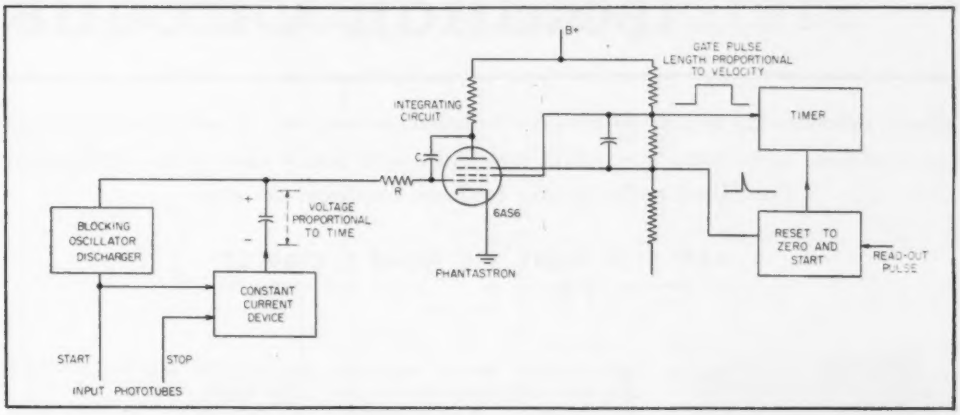


FIG. 5—Integrating a fixed voltage proportional to elapsed time until a preset voltage is reached requires a time interval proportional to velocity. Length of timer grating pulse from phantastron measures integration time

dynamic breaking at the null, but also permits insertion of a lead network. This network applies, through the capacitor, a larger-than-normal voltage change of suitable polarity during any transition between the three states of motion and thus provides extra fast response. This is true whether the discharged capacitor allows a larger-than-normal current surge to start the motor, or the charged capacitor discharges in the reverse direction to stop the motor. If R and C are matched to the motor one can apparently cancel armature mass and tolerate a smaller dead zone.

In the bridge circuit, one need only interchange two adjacent arms to display elapsed time rather than speed. With meter indication one would have to pass a constant current through the resistor chain and place a voltmeter across it.

If an event consumes appreciable time, a motor-driven potentiometer will furnish a resistance increasing linearly with time. The input devices can activate a small magnetic clutch to provide instant starting.

Capacitor-Charge Timer

Instead of counting cycles arriving at a uniform rate, it is possible to charge a capacitor from a constant-current source. This then provides a linearly-increasing voltage and a final voltage proportional to time. Constant current can be supplied by pentodes, beam power tubes, saturated diodes, phototubes with constant illumination and cascode amplifiers or other feedback systems.

The voltage proportional to time, can be converted into a corresponding resistance by passing constant current through a variable resistor and adjusting it until its voltage drop equals the input voltage. A servomechanism can then be used in a bridge-balancing circuit.

Voltage proportional to time can also be impressed across a potentiometer having a constant-voltage source in series with its arm. If the arm is driven by a servomechanism until the voltage tapped off the potentiometer balances the voltage in its arm, the resistance from arm to ground will be proportional to speed.

Other Circuits

Another circuit is indicated in Fig. 5. Here the voltage proportional to time is integrated with respect to time until a preset value is reached. Integration time is inversely proportional to elapsed time. An indication proportional to this new time gives speed. The indicator can be a second capacitor charging at a constant rate during integration and observed with a voltmeter or a standard scaler counting cycles from an oscillator.

These methods can incorporate instantaneous reset at the start of each new count if a discharging high current is delivered to the capacitor. Discharging current of the order of an ampere can be delivered by a blocking oscillator.

A constant voltage gated into one of the more precise integrating circuits will also provide a voltage increasing linearly with time. A binary-counter system can likewise be used wherein each successive stage switches a resistor half as large as the one previous; the output voltage will stair-step linearly with time.

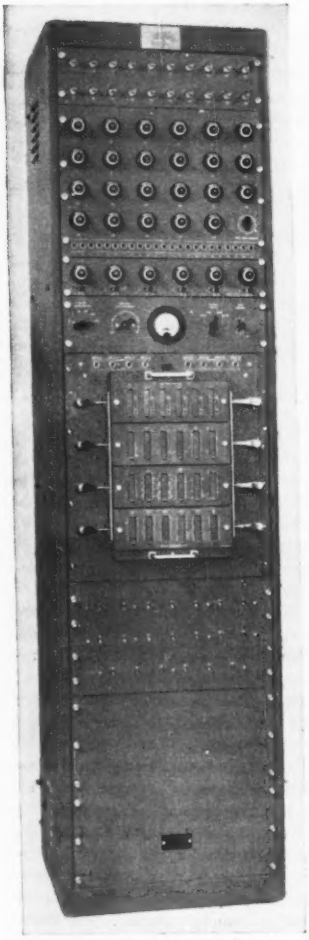
A capacitor can be charged linearly and the voltage passed through any device with a logarithmic response. The derivative of this signal is proportional to $1/t$ and drops sharply to zero at the end of the interval. The magnitude of this drop is proportional to the reciprocal of the total time involved.

A final scheme starts with a fully-charged capacitor, and to discharge it during the interval with some device having a voltage-current characteristic of i proportional to V^n. One can obtain such a response from a biased-diode, arbitrary-function generator. The final voltage on the capacitor is a linear measure of speed.

Isolation Circuits

Cathode followers fail to provide adequate isolation for computer circuits. Output circuits described have high input, low output impedance with nearly unity gain. Differential amplifiers and high-gain feedback amplifiers are used

By **RAWLEY D. McCOY** and **FRANK R. BRADLEY***
Reeves Instrument Corporation *New York 7, New York*



Electronic analog computers, such as REAC, require isolation circuits better than the usual cathode follower. Special isolation circuits designed for this computer are described in detail.

ELECTRONIC ANALOG computers place stringent requirements on their isolation or buffer circuits. Ideally such circuits should have infinite-impedance input, zero-impedance output circuit and exactly unity gain.

The cathode-follower circuit, the elements of which are shown in Fig. 1A, is not adequate for most computer applications. The two basic isolation circuits to be described were developed in conjunction with the REAC (Reeves Electronic Analog Computer).

Voltage gain of a cathode follower is

$$\frac{\mu}{(\mu+1)+\frac{r_p}{R_K}}$$

By making μ large, the overall gain can be made close to unity and, the output impedance reduced. Figure 1B illustrates a method for accomplishing this. The output voltage is produced by the cathode follower, but the difference between output and input voltage is measured by a differential amplifier and amplified in two stages before being applied to the cathode follower. The effective μ of the cathode follower is then $G_1G_2\mu$ and the overall gain close to unity.

D-C Application

Figure 2A shows a d-c isolation amplifier. One grid of the 5691 is returned to the cathode of the 6SN7 as is the cathode of the 6SJ7. The 5691 is connected as a differential amplifier so that its output voltage is the amplified difference of its inputs.

If both input grids swing positive at the same time, the net grid-to-cathode voltage change of the first grid remains unchanged because the cathode follows the second grid. Plate voltage is therefore unchanged. If the second grid swings negative while the first grid goes positive, the net grid-to-cathode voltage change of the first grid is the sum of the two inputs, hence the plate voltage change is proportional to the sum of the input voltages.

The differential amplifier has an appreciable gain because of its 350,000-ohm plate resistance. Its output is amplified in the 6SN7 and the total output applied between grid-and-cathode of the 6SN7 in a bootstrap arrangement.

Bootstrap Circuit

Plate voltage for the bootstrap stages is supplied by two 5651 voltage-regulator tubes, which are referred to the output voltage. No matter what the voltage swings are required of the circuit, the bootstrap-amplifier tubes operate at the same place on their characteristic curves. This makes the amplifier virtually independent of the characteristics of input tubes.

A bias potentiometer is included in the cathode of the 6SJ7 to set the stage operating point and anti-sing networks are included in the coupling between the first and second stage and from grid to plate in the second stage. These shape the open-loop amplifier response curve to attenuate amplifier gain

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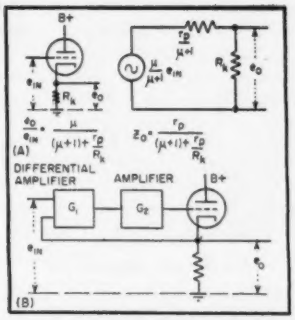


FIG. 1—Cathode follower (A) has nearly unity gain when used with a differential amplifier (B)

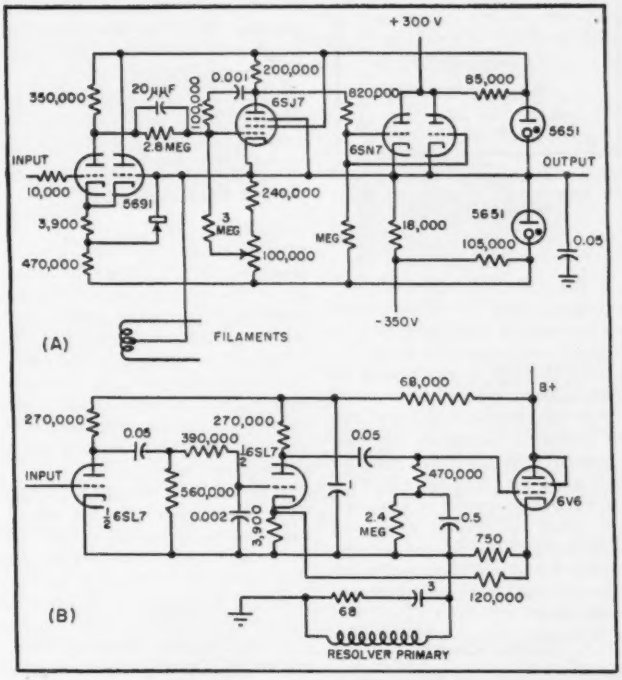


FIG. 2—Isolation amplifier using cathode follower and differential amplifier is suitable for either d-c (A) or a-c (B) application

below unity before the phase shift approaches 180 degrees. A crystal diode is used in the second grid input circuit of the 5691 to eliminate the possibility of the circuit settling in a stable but nonoperable condition. If, on starting, the grid should go positive with respect to the plate, the stage would remain in that condition. The crystal prevents this by limiting the grid-to-cathode voltage.

A-C Application

An a-c version of this circuit, used at 60 cps as a resolver buffer amplifier is shown in Fig. 2B. This circuit, developed by P. A. Seay, was the predecessor of the d-c circuit. The circuit is a-c coupled and interstage antising networks used. Since it is necessary to shape frequency response at both the high and low ends, the networks are more complex. The input amplifier cathode is returned to the output rather than to a differential amplifier since the succeeding a-c coupling eliminates d-c level adjustment problems, which dictated the differential amplifier used in Fig. 2A.

The cathode load is a 750-ohm resistor in series with a parallel R-C network across the resolver primary. The network consists of a three-microfarad capacitor and a 68-ohm resistor and provides power factor correction for the inductive resolver load.

Operating point of the second amplifier stage is set by the voltage divider consisting of the 120,000 and 3,900-ohm resistors from the 6V6 cathode to the output.

The decoupling network consisting of a 68,000-ohm resistor and one-microfarad capacitor between the 6V6 and 6SL7 plate supplys replaces the two VR tubes used in the d-c version of this circuit. The capacitor refers the 6SL7 plate supply to the a-c output voltage so that the 6SL7 operates in the same portion of its characteristic curve and the circuit is relatively stable despite tube variation.

The isolation circuit shown in Fig. 3A uses high-gain feedback amplifiers. The voltage at the potentiometer arm drives a low or varying-impedance load. Without isolation, load variations would affect the voltage at the potentiometer arm.

High-Gain Amplifiers

High-gain phase-inverting amplifiers, when connected in feedback circuits as shown, develop an output voltage that cancels the input voltage. Thus the voltage at the output of the first amplifier is $-e$ and the voltage division between e and $-e$ across R_1 and R_2 gives a null at the grid. Similarly, the voltage at the output of the second amplifier is $2e$. The junction of R_1 and R_2 is a virtual ground and the output voltage, $2e$, divides across R_1 and R_2 to give

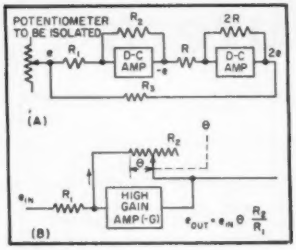


FIG. 3—Alternative isolation circuits use either one (B) or two (A) high-gain feedback amplifiers

e at the potentiometer arm. Current drawn from the potentiometer can be reduced essentially to zero by precise adjustment of R_2 so that current through R_1 is supplied by the second amplifier.

With this circuit, high input and low output impedances may be achieved. It is necessary for stability that the impedance looking into the potentiometer be a reasonable value, depending upon the phase and gain margin of the amplifiers. Resistor R is normally one megohm and the potentiometer 30,000 ohms.

Actual Circuit

A circuit, suitable for potentiometer unloading at 400 cycles is shown in Fig. 4. It consists of a three-stage amplifier, V_{1A}, V_{1B}, V_2, and a single-stage amplifier V_3 both of specified gain.

Resistors R_1 and R_{12} provide negative feedback around the three-stage amplifier and R_{13}, R_{14} and R_{15} provide feedback around the single-stage amplifier.

Since the sources of amplifier phase shift are the reactive components, it would be desirable to use d-c coupling to eliminate entirely the causes of low-frequency oscillation. This cannot be done because of the problem of drift. The first and second stages are, however, d-c coupled, the resultant drift being eliminated by the capacitance coupling.

A high-frequency bypass network, R_5 and C_2 is, coupled from the plate of V_{1B} to ground. This attenuates the amplifier output on high-frequency side of the passband.

The coupling network between the second and third stage consists of C_3, C_4 and R_6. Primary coupling in the passband is accomplished by C_4. At lower frequencies the impedance of C_4 becomes large and coupling is accomplished by C_3 and R_6. In this fashion, gain in the passband is maintained while the effective time constant of the coupling network is very large, due to the large value of R_6.

Passband Boost

A choke is used to increase the dynamic range of the stage, permitting the output voltage to swing above $B+$ by self-induced voltage. Capacitor C_5 and the choke's distributed capacitance resonate the choke in the passband resulting in steep attenuation of gain on either side. This is permissible since phase shift around the passband is small and the steep slope will not result in oscillation.

It is desirable to attenuate the gain as much as possible where the phase shift is small so that the frequency range over which the phase shift must accurately be controlled is a minimum. Resistor R_5 reduces the Q of the plate load to give the amplifier sufficient bandwidth. The single-stage amplifier is a cathode-biased pentode. For perfect isolation, the amplitude and phase of positive-feedback current must be the same as that of the input signal. The positive feedback amplifier input is tapped from voltage divider R_{13}, R_{14} and R_{15}, the stage gain being determined by the setting of R_{15}. Capacitor C_9 across feedback resistor R_{12} permits adjustment of phase of positive feedback. Thus the amplitude and phase of the positive-feedback current may be adjusted for ideal operating conditions. Capacitor C_9 is particularly important when long runs of shielded wire introduce capacitance to ground.

Zero Source Impedance

The last scheme is superior to the others in many applications. Figure 3B indicates a method of isolation using a single high-gain feedback amplifier. The circuit is demonstrated for potentiometer isolation but it is applicable to other problems as well.

The high-gain phase inverting amplifier in a feedback arrangement maintains its input grid at a virtual ground and there is little or no grid-current flow. Thus the current indicated is independent of the potentiometer position and the voltage at the arm is independent of the load. The source impedance to the load is then the impedance looking into the feedback amplifier, normally a small fraction of an ohm.

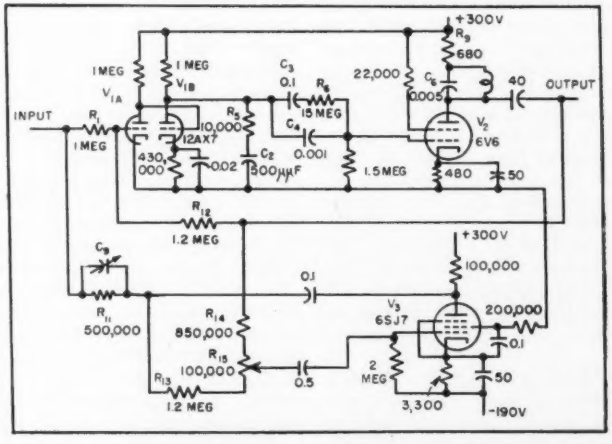
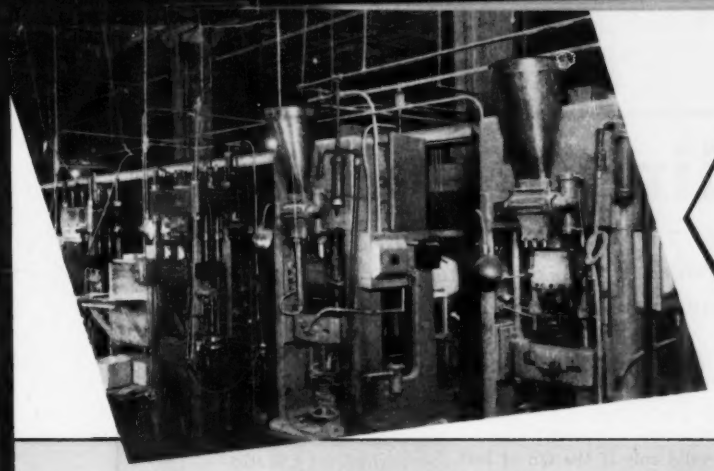


FIG. 4—Isolation is accomplished using two high-gain feedback amplifiers. One amplifier consists of three stages, other is a single stage



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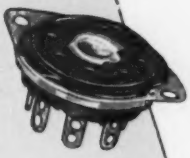

(Above) CINCH *Octal* molded socket, 1-5/16" Mtg. Center, 1-1/2" M.C. available. (Left) Loktal Molded Socket, 1-5/16" mtg. Center.

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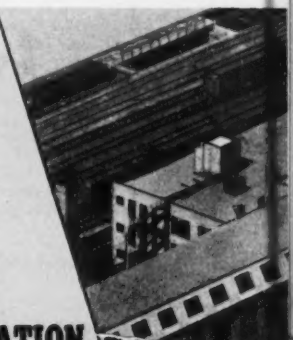

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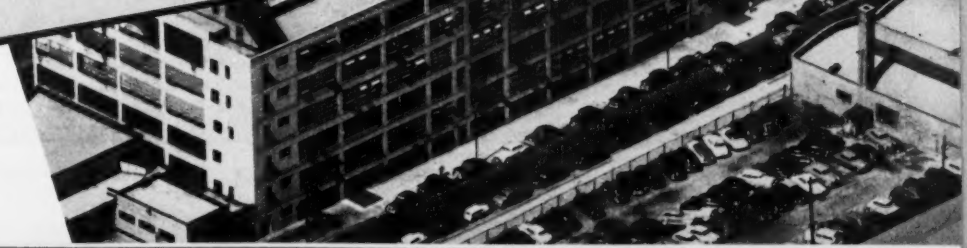


R-F Coupling Nomograph

Gives coefficient of inductive coupling of an r-f transformer directly from Q-meter measurements. Procedure permits correcting for effects of distributed capacitance

By RAYMOND E. LAFFERTY
Engineering Development Group
National Broadcasting Co.

WHEN MEASURING the coefficient of inductive coupling of an r-f transformer with a Q-meter, one winding of the transformer is connected to the inductor terminals of the Q-meter and the capacitance of the Q-meter circuit is tuned to resonance with the second winding open to give C_1, and shorted to give C_2. Then

$$k = \sqrt{1 - (C_1/C_2)} \qquad (1)$$

Equation 1 also neglects the effect of distributed capacitance in either or both windings, and is valid only if the Q's of both windings are greater than 10. Where primary distributed capacitance C_p and secondary distributed capacitance C_s are both present to a significant degree,

$$k = \sqrt{1 - U} \qquad (2)$$

where $U = \dfrac{1}{(1 - \gamma^2)\left(\dfrac{C_2 + C_p}{C_1 + C_p}\right) + \gamma^2}$

$\gamma^2 = (f/f_o)^2$
f = Q meter frequency
f_o = self-resonant frequency of secondary, or $1/2\pi\sqrt{L_sC_s}$

Where C_p is significant and C_s is negligible ($\gamma^2 \cong 0$);

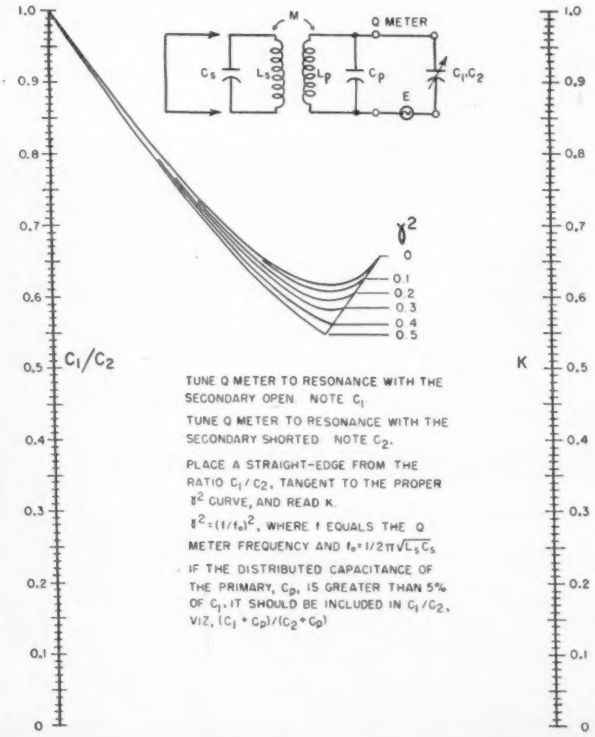
$$k = \sqrt{1 - V} \qquad (3)$$

where $V = (C_1 + C_p)/(C_2 + C_p)$

Where C_s is significant and C_p is negligible ($C_p < 5$ percent of C_1);

$$k = \sqrt{1 - W} \qquad (4)$$

where $W = \dfrac{1}{\left(1 - \gamma^2\right)\dfrac{C_2}{C_1} + \gamma^2}$



The nomograph is used by extending a straight-edge from C_1/C_2, tangent to the correct γ^2 curve, and reading its intersection with the scale for k. If C_s is small enough to be neglected, γ^2 is approximately zero and the zero curve should be used.

If both windings of the transformer have appreciable capacitance, C_p and f_o should be measured before the coils are inductively coupled.

Example 1. The Q-meter tunes to 460 kc with 210 μμf of capacitance when one winding of an r-f transformer is connected to the inductor terminals and the other winding is left open. When the second winding is shorted the Q-meter capacitor must be increased to 375 μμf to maintain resonance at 460 kc. The self-resonant frequency of the secondary is found to be 840 kc, and C_p can be considered negligible. From this, $C_1/C_2 = 0.56$ and $\gamma^2 = 0.3$. Using the nomograph, k is 0.6.

Example 2. $C_1 = 95$ μμf, $C_2 = 116$ μμf, $C_p = 15$ μμf and C_s is negligible (hence $\gamma^2 \cong 0$). From these data, $(C_1 + C_p)/(C_2 + C_p) = 0.84$ and the nomograph shows k to be 0.4.

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ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

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Automatic Communications System

BY J. D. LANE

General Engineering Development Co.
Boston, Mass.

AUTOMATIC MESSAGE and/or signal collection and repeating for communication networks is accomplished by a device known as the Robo-Communicator, which may be used as a terminal equipment for automatic answering of calls. The equipment will also record two-way communication network conversation and office conference and it will record and reproduce spoken messages and other types of signals.

When answering a call, the communicator responds to call signals so as to impress a station identification announcement on the coupled communication system for a timed interval. This broadcast may include a voice message to instruct the calling station that it is connected to a signal recording device at the called station that will make an electrical transcription of message transmission.

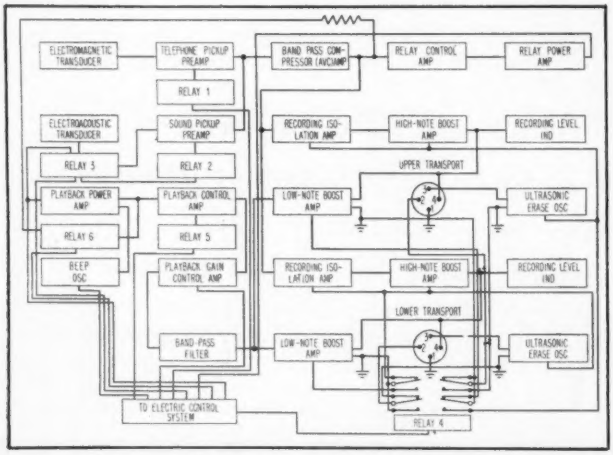
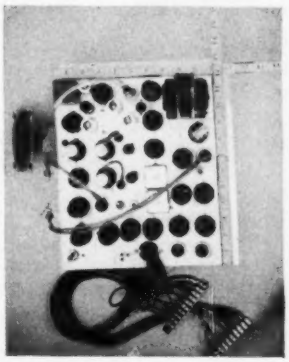


FIG. 1—Block diagram of the amplifier for the Robo-Communicator



Amplifier chassis for the communicator

A further announcement may state that the message to be stored will be received by the called party at his earliest convenience. The machine then shifts automatically into condition for recording reception of the calling station's message. At the completion of the call, the machine disconnects itself from the communication network and waits to receive further calls.

The amplifier is shown in block-diagram form in Fig 1. Various circuit combinations to be mentioned are controlled by selective switching apparatus located remote from the amplifier tubes.

When using the machine with an external communication system, it is desirable to broadcast beep signals from the beep oscillator, Fig. 1, so that a caller will receive signals to distinguish recording pe-

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The G Meter, 192-A, employs a crystal controlled oscillator to supply a constant amplitude voltage to a high quality reference tuned circuit. A calibrated precision loss circuit and a differential VTVM are internally connected across the resonant circuit. External means are provided for connecting test samples across the same resonant circuit. By substituting internally connected values of calibrated loss and capacitance for the test sample, to secure a reference voltage, the conductance and capacitance of the sample may be determined. The differential VTVM provides very great sensitivity to changes from the reference voltage allowing very accurate settings of the conductance and capacitance dials.

SPECIFICATIONS

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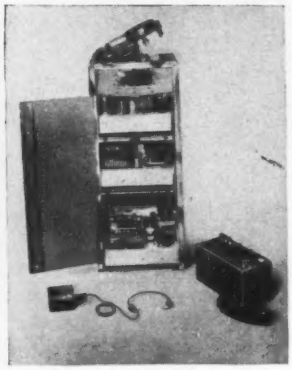
BOONTON, N.J. U.S.A.

riods from dead-system condition whenever the machine is used to record messages from a remote station. The electromagnetic transducer together with the following block components constitute a receiver-amplifier system for signals to be recorded from an external communication system.

The receiver-amplifier system includes the band-pass compressor (avc) amplifier, the recording isolation amplifier and the high-note boost amplifier which supplies recording signal power to the voice coil on one of the wire transports. Calling signals are tapped from the output of the avc circuit and coupled to the line by the relay control amplifier and the relay power amplifier.

Relay 1 is energized to close a cathode circuit to ground when the telephone pickup preamplifier is used to complete coupling to an external communication system via the electromagnetic transducer. When acoustic signals are picked up from the vicinity of the machine's microphone, relays 2 and 3 are energized to put the sound pickup components in operation to feed signals to the receiver-amplifier.



Model of the equipment for use as terminal equipment

When it is desired to broadcast signals stored on the lower transport, relay 4 is energized, its contacts are pulled down and the low-note boost amplifier is energized. The amplifier couples the voice coil on the wire transport to the band-pass filter, playback gain-control amplifier, the playback control amplifier and the playback power amplifier unit.

Relay 4 controls the coupling of electronic components to both transports so that when one transport is coupled for playback operation, the other will be coupled for recording and vice versa. Feedback isolation of circuits to be coupled to the two transports is provided by using relay 4 to control the action of coupled amplifier units as well as the erase oscillators. Isolation amplifier circuits effectively isolate the two transducers so that one transport may be coupled to record from any communication network that is directly energized by playback from the second transport.

When it is desired to copy a recording from the lower transport and record the lower transport signals on the upper transport, as for editing and dubbing-in operations, the playback circuits mentioned previously are energized. Relay 5 is energized also to complete connection from the playback circuit to the recording circuit.

Gated Lamp Decade Counters

By Robert L. Rod

Assistant Director of Research
Bogue Electric Manufacturing Company
Paterson, New Jersey

AMONG MANY electronic counter circuits devised during the past few years, the scale-of-ten decade counter is perhaps the most widely used. The particular feedback circuit devised by Grosdoff[1] utilizing neon lamp decimal read-out is finding many applications in frequency measuring and similar systems which are used to count events per unit time.

Generally, decimal indicating decades are used to count an unknown number of pulses occurring during a definite interval of time. Some time after this summation process has been completed, the decade counters are either electrically or manually reset to zero prior to the onset of another cycle of counting operation.

Whereas, the individual neon

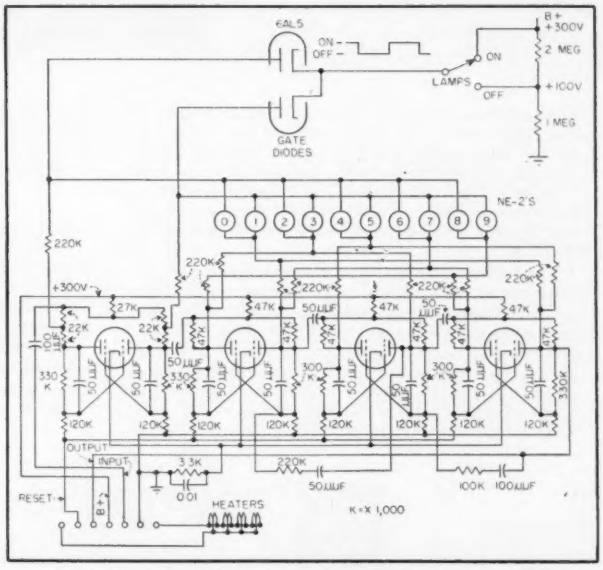


FIG. 1—Gated lamp decade modifications. Counter tubes are 12AU7's

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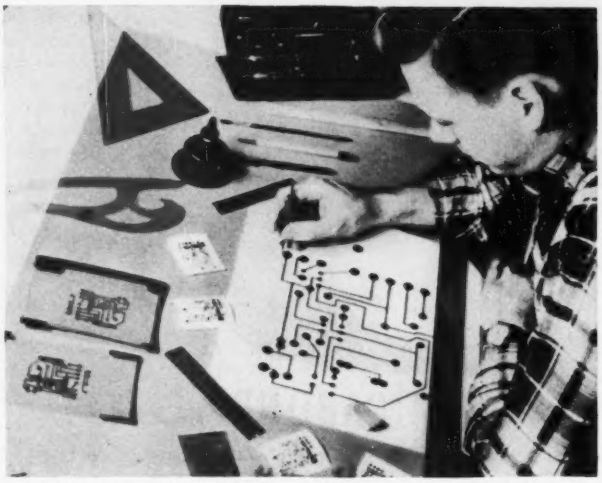

SHOWN in the cover photographs and the accompanying photograph are steps in the Auto-Sembly System of circuit fabrication. The elements of this Signal Corps process are the insulating base chassis bearing the circuitry with conventional components in their proper position on the blank side and all component leads passing through perforations to the circuit side of the chassis. Application of a suitable soldering flux, solder dipping and removal of excess component leads completes the assembly.

Patterns of subminiature circuits requiring great accuracy are drawn three or four times original size and reduced to actual size photographically. Advantage of the enlarged drawing may be taken to include lettering, terminal designations or other circuit details before reduction to the required size. Precision of conductor size and spacing is a further advantage.

lamp indicators in a particular decade are continually advancing during the summation cycle, only one particular lamp remains lit after the count is terminated until the circuit is reset. In applications where the "on" or counting time is appreciably more than the subsequent "hold" time prior to reset, the observer is annoyed by a flickering effect during counting that can very well obscure the final reading. In the extreme case where the decade is reset to zero shortly after the termination of counting, the final reading is not clearly distinguishable.

Means for gating off the lamps and eliminating the flickering during the counting interval without affecting the dividing action of the individual scale-of-two stages are useful during high-duty-cycle operations. The arrangement shown in Fig. 1 above the neon diodes is an auxiliary gating system designed to satisfy this requirement.

In this type of decade, representative of many commercially available units, the neon lamps are energized by a sufficiently great peak-to-peak voltage developed from a combination of a positive-going square wave derived from the head odd-even binary and a composite negative-going waveform obtained from combinations of the outputs of the three succeeding stages. By individually clipping the positive output pulses of both sides of the first stage by means of the auxiliary gating diodes, the neon lamps fail to light on the remaining negative-going voltage pulses derived from the subsequent binaries because of insufficient impressd voltage.

Biasing the gate diode cathodes at the supply voltage will effectively open-circuit the diodes and permit normal operation of the lamps. Lowering the voltage to 100 volts or so will cause the diodes to slice the odd-even square waves sufficiently low in amplitude to keep the lamps out.

This gating technique may be useful in the simplest case with manual selection of the gating voltage applied to the diode cathodes. In those applications using pulsed timing oscillators whose shaped pulses are counted by decade counters, the oscillator gating waveform itself can be directly applied to the gate diode cathodes to gate the lamps on and off.

Germanium or selenium diodes can be used for this application providing that their reverse resistance is sufficiently high. However, the use of vacuum diodes results in far more stable and reliable operation of the system. Either a subminiature dual diode integral to the decade itself or an external tube such as a 6AL5 can be used as desired. In any event, with the diodes integral to the decade itself only one additional terminal is required for this modification.

REFERENCE

(1) I. E. Grosdoff, Electronic Counters, *RCA Review*, 7, p 438, Sep. 1946.

Compound Sweep Circuit

BY JOHN H. PORTER

Office of Naval Inspector of Ordnance
Navy Ordnance Division
Rochester, New York

FREQUENTLY it is desirable to examine in its entirety a fairly long transient whose initial rate of change is considerably different than the rate during the rest of the interval. The circuit shown in Fig. 1 was developed to provide a sweep voltage to photograph a transient lasting for 100 seconds and which arrives at 75 percent of its maximum value in approximately 0.1 second and which decays to about 85 percent of its maximum

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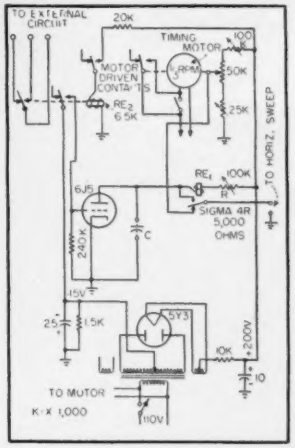

FIG. 1—Schematic diagram of the sweep circuit

value during its duration.

The time span is broken into two intervals and individual sweep voltages are provided for each interval. The initial sweep is short, lasting from 0.02 to 1 second depending on the C and R used, while the second sweep lasts up to 3 minutes.

Initially, the tube is without bias and draws sufficient current to hold R_{y1} closed and keep the output connected to the tube plate. To initiate the sweeps, the timing motor is started and upon reaching synchronous speed, puts cutoff bias on the tube via R_{y2} and with the same relay energizes an external circuit as desired.

As the energy contained in the coil of R_{y1} is dissipated in the capacitor C through the timing resistance R, the voltage across C rises and eventually R_{y1} drops out. It is this rise of voltage, limited to but a volt or two, that provides the fast sweep.

When R_{y1} opens, the output is connected to a potentiometer across the power supply and driven by the timing motor. The control used is an Ohmite AB with the stop removed to allow 360 deg rotation. The voltage gradient across the motor-driven potentiometer is adjusted to be the same as the change in voltage across C after R_{y1} opens.

This circuit has been used with a Land-Polaroid camera for single-

This eye spots *fast-moving trouble*

The Kodak High Speed Camera is shown here recording on film what happens at the "break" of a relay. Electrical aspects, shown on an oscilloscope, are recorded simultaneously on the same film by means of a special attachment.

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This high speed "eye" is daily solving complex problems of design, production, and product performance—problems where usual methods of analysis would be slow and costly. One manufacturer projects high speed movies within two hours after they are taken—the solution to a problem is on the drawing board the same morning it is discovered. We'd be glad to send you, with our compliments, a folder showing how this company uses the Kodak High Speed Camera so effectively. Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y.

the Kodak *HIGH SPEED* Camera

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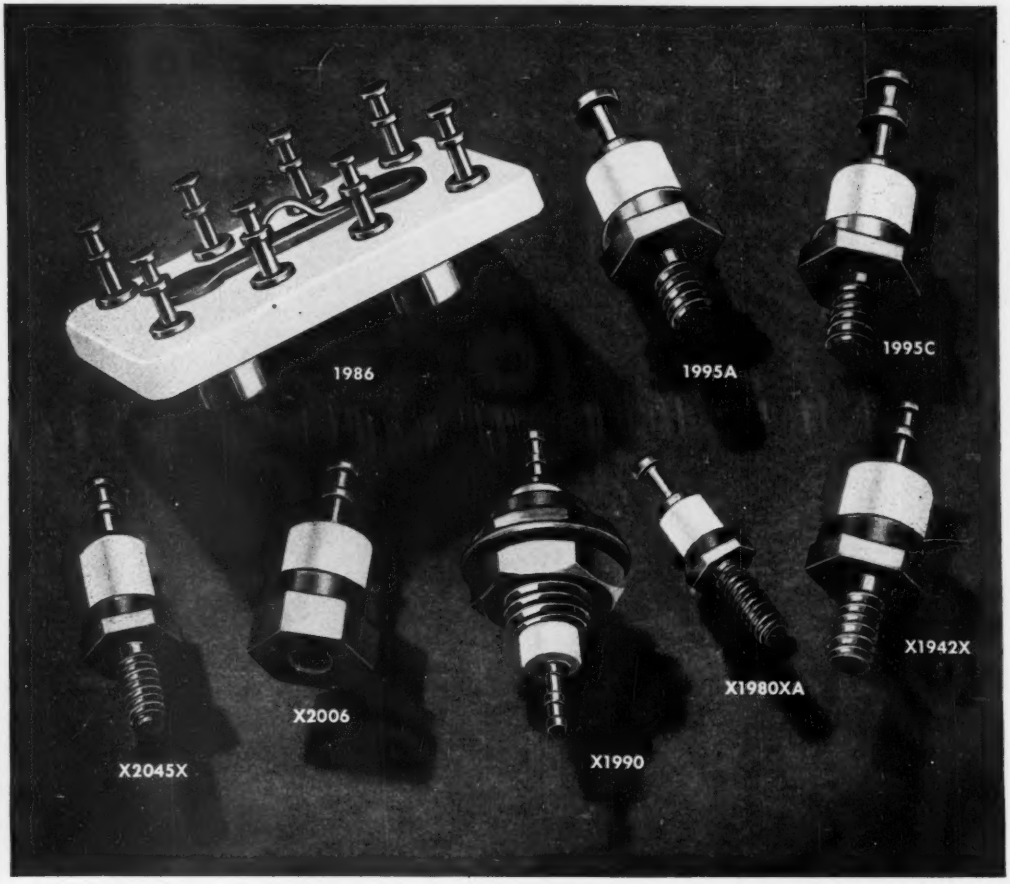

Units shown magnified approximately 2½ times

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BI-SEAL INSULATION CHARACTERISTICS

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Dielectric strength	1000 volts/mil avg.	
Power factor	60 cycles	0.0006
	1000 cycles	0.0006
	10⁶ cycles	0.0004
Dielectric constant	60 cycles	2.32
	1000 cycles	2.34
	10⁶ cycles	2.13

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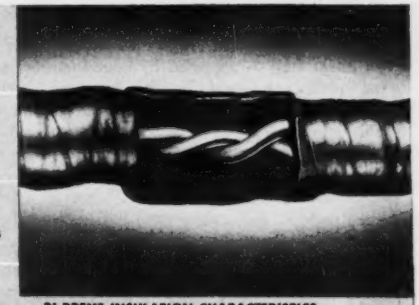

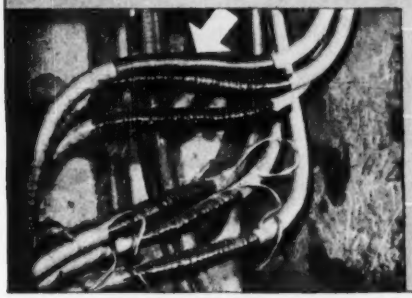

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A.S.T.M. Reference fluid number one—11.7% maximum swell in 24 hrs. A.S.T.M. Reference fluid number two—69.7% maximum swell in 24 hrs. 18 hr. exposure in oil at 121°C —Tensile decreased 4.5%. Elongation increased 70%.

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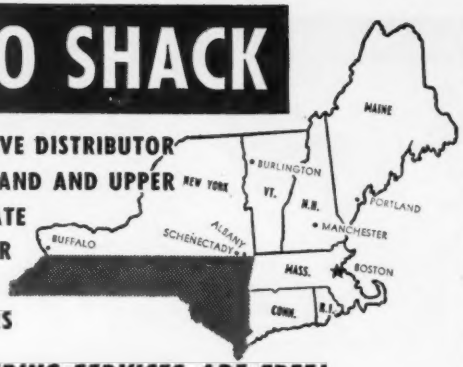

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shot photography of a transient initiated by R_{p2}. The relay selected for R_{p1} is a Sigma 4R with coil resistance of 5,000 ohms. The drop-out current for the particular relay used is approximately 1.5 ma and is obviously independent of the initial rate of sweep. Since it is desirable to reduce the beam intensity for the long sweep, a relay with additional contacts might be chosen for R_{p1}, to control the crt bias.

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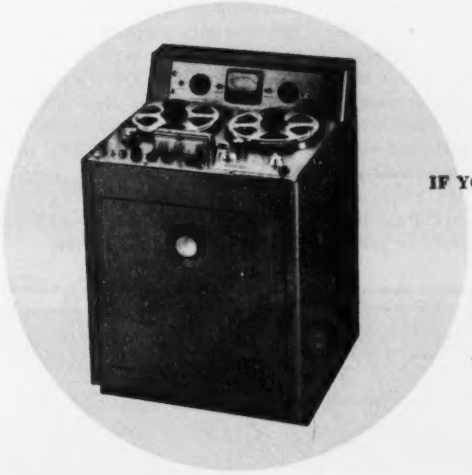

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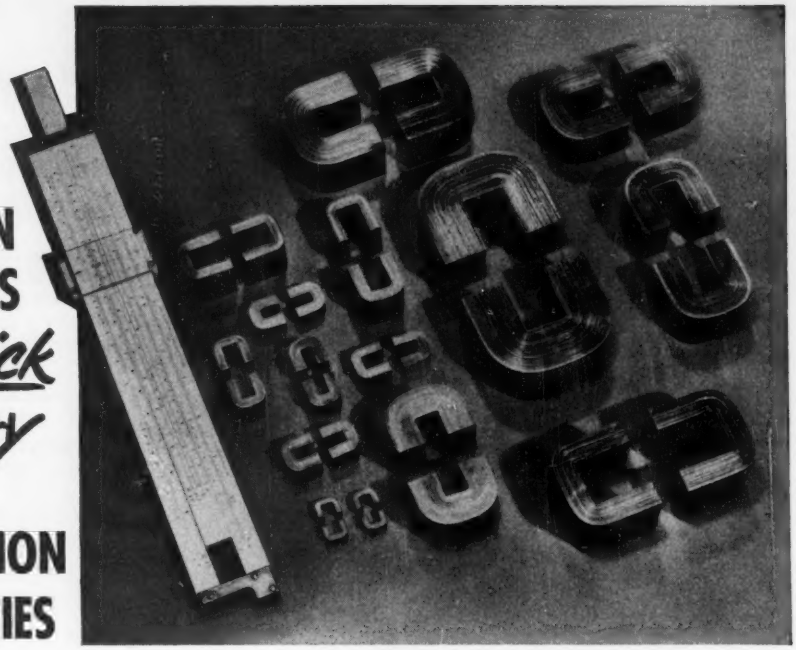

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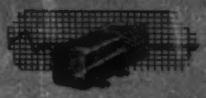

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Output adjustable from 0-130 volts

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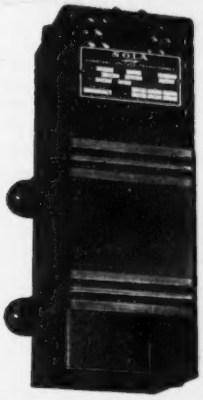

SOLA television receiver type CVA:

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Plug-in accessory unit

SOLA plate and filament type CVE:

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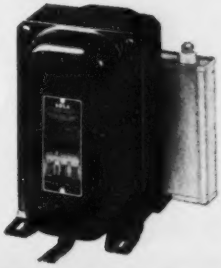

SOLA harmonic filtered type CVH:

Regulation ±1%
Harmonic Distortion less than 3%

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- Stable electromagnetic regulation
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where

dependable timing

is essential

to product performance

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BOX 3, CENTERBROOK, CONN.

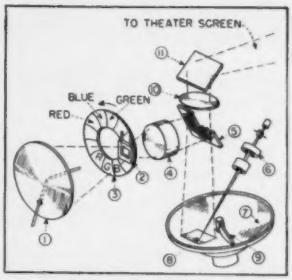

FIG. 1—Mechanical drawing of the projection system. Arc light source (1), aperture plate (2), color wheel (3), condenser lens (4), mirror bar system (5), electron gun and deflection system (6), spherical mirror with thin layer of liquid (7), electron bombarded liquid area that modulates light beam (8), knife edge determining thickness of liquid layer (9), projection lens (10) and directing mirror (11)

with temperature, changes in temperature cause a difference in the rate of the disappearance of the picture or any given portion of it. The correct temperature is maintained by a cooling machine which circulates water on the under side of the mirror. The water temperature is adjusted automatically by a thermostat.

The entire mirror system is maintained continuously under high vacuum. The mirror is driven by a motor outside the vacuum system operating through a specially packed shaft. A large vacuum line leads from the mirror system to a high vacuum pump. The pressure in the mirror system is kept at 10^{-6} millimeters of mercury.

Arc Light

The system utilizes a special arc light which gives a completely symmetrical arc. Air is blown continuously around the positive carbon to stabilize the arc. Magnetic stabilization is also provided. These two types of stabilization give a constant arc of constant brightness. It is essential with color to have a uniform arc light. The lighting density required by the Eidophor system is much higher than with the ordinary movie projection systems. About twice as much current is fed to the arc.

The positive carbon is fed by a photoelectrically-controlled device which keeps the crater exactly in

There's a DPi high vacuum measuring instrument for every laboratory and industrial requirement

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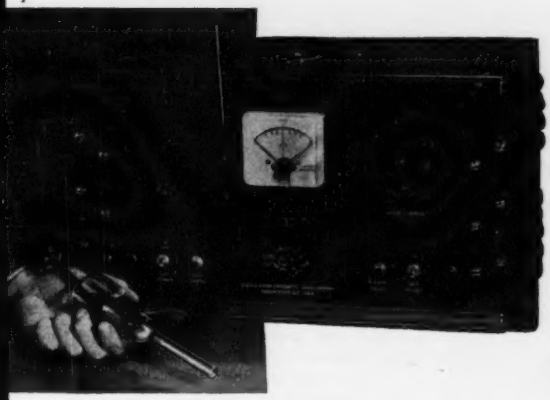
For the range from 10^{-3} to 10^{-5} mm Hg, DPi's Knudsen Gauge, Type BL-1, is a radiometer gauge with a constant response that is essentially independent of the nature of most gases. Readings are absolute, giving total gas and vapor pressure. With no incandescent filament, better accuracy is assured in measuring vacuums in systems where gases are subject to decomposition. A magnetic damper provides stable readings without loss of sensitivity. And it can be attached to any system by standard glass or metal joints.



For the range from 1 micron to 1 x 10^{-8} mm Hg, DPi's Type VG-1A Ionization Gauge Tube, sealed in your vacuum system, provides the sensitivity required for measuring pressures as low as 10^{-8} mm Hg, yet is reliable at pressures of 1 micron. Its design reduces electrical leakage and outgassing to a minimum.

The DPi DPA-38 Ionization Gauge Control Circuit affords a completely self-contained power and amplifying unit for an ionization gauge tube—saves you the time and trouble of building your own. Designed for use with the VG-1A tube, but adaptable to others, it provides a tube degassing circuit. An automatic relay turns off gauge tube and turns on power for an alarm system when pressures exceed safe limits. Its very large range and continuous direct readings widen the DPA-38's application and make your work easier.

Both the Knudsen Gauge and the DPA-38 will hold calibration indefinitely and operate from any 115-v a-c outlet. And both are the result of nearly 20 years of experience in making high vacuum easy and economical to produce, measure and use. For more detailed information and prices, or engineering help on any problem involving high vacuum, write to ***Distillation Products Industries,*** Vacuum Equipment Department, 727 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).

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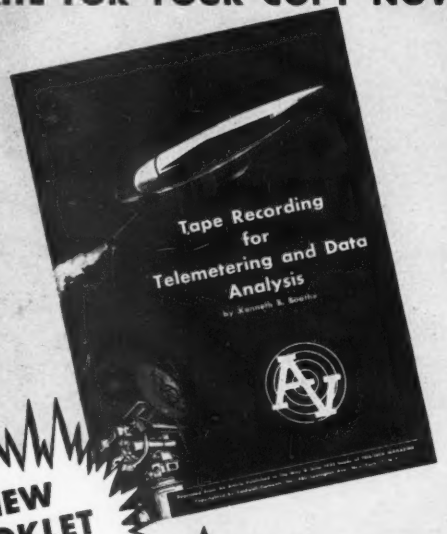

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the focus of the mirror behind the arc, the best position for the most light. The negative carbon is fed in the conventional manner using the negative characteristic of the arc to control its feeding. As is conventional, the positive carbon is consumed about twice as fast as the negative.

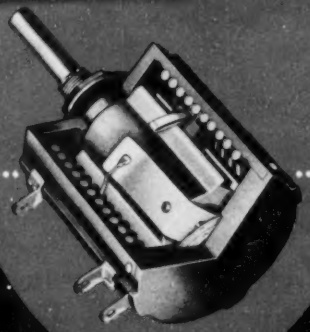
Light from the arc is directed through a gate, see Fig. 1, then through a rotating color wheel, into a condenser in the wall of the vacuum system in which the mirror is located. After the light goes through this condenser, it strikes a mirror bar system made of a group of spaced reflective bars with the space between the bars approximately equal to the width of the bars.

Half of the light from the arc goes straight through the openings between the bars and strikes a water-cooled black surface in the vacuum housing and is lost. The other half of the light from the arc is reflected down by the bars onto the mirror with the film on it, striking the film over the area where the image is found on the oil film. If there is no picture on the film and consequently no deformation of the surface of the liquid, the mirror reflects the light back to the bars and then back to the arc lamp. If there is a picture on the film because of an incoming television signal, the light hits the picture and is reflected back between the bars, through a normal objective lens with its axis vertical, to a mirror inclined at 45 deg and then to the screen on which the picture is projected.

The picture is formed on the surface of the film by an electron beam generated by an electron gun of conventional type activated by the incoming television signal and located in the vacuum system.

Small Wire Capacitors

THE WIRE CAPACITOR developed by N. V. Philips, Eindhoven, Netherlands, has a capacitance of about 100 $\mu\mu$f and, in its most common form, consists of a small metal tube less than 1 mm in diameter and about 5-cm long. The tube contains a metal core about $\frac{1}{2}$-mm thick while



From the world's largest manufacturer of precision potentiometers . . . **Helipot**

come to Helipot *for the largest selection of* multi-turn *precision potentiometers*

advanced engineering! volume production!

HELIPOT is the organization that originated the helical potentiometer—the device that brought to electronic engineering new horizons of precise control by its greater resolution, higher linearity, mechanical precision, and broad range of resistance values. HELIPOT'S policy of constantly working to anticipate the needs of the industry has led to steady advancement in the basic multi-turn principle—and today, HELIPOTS are available in the industry's widest selection of ranges and designs to meet varying requirements.

HELIPOT offers you . . .

▶ **Advanced Engineering.** Through its years of leadership HELIPOT has built an organization unequalled in the industry—with trained engineers, specially-designed equipment, overall facilities to solve *tough* potentiometer problems!

▶ **Volume Production of Special Designs.** HELIPOT not only welcomes tough potentiometer problems, but also has expanded facilities to mass-produce special designs to rigid specifications—at economical cost!

▶ **Versatile Basic Designs.** Most of the basic units shown below can be readily adapted to special requirements—ganged assemblies, servo mountings, angle or double shaft extensions, taps spot-welded to a *single* turn of winding at virtually any desired point, and many other individualized features to meet *your particular needs!*

See the next pages for complete electrical and mechanical data on the following Multi-Turn Helipots . . .

MODEL A:
A 10-turn unit, approximately 1¼" diameter with 12 to 14 times the resolution of single-turn units of same diameter. Very versatile—low in price—wide range of applications.*

MODEL C:
Similar to Model A, but 3 turns of resistance winding instead of 10.*

MODELS B, D, & E:
Larger-diameter (3 5/16") designs. B has 15 turns—D, 25 turns—E, 40 turns, for applications requiring extreme ranges of adjustment and highest possible resolution.*

ultra-precision

MODELS AN, BS, BSP, & CN:
Similar to Models A, B & C in size and performance but feature precision ball-bearings and extra-close tolerances throughout. Have approximately twice the linearity accuracy of equivalent standard Helipots—are ideal servo units.*

miniature

MODELS AJ, AJS, AJSP:
Tiny multi-turn Helipots the diameter of a penny, weight 1 oz. All have 18.5" slide wire for high resolution (1/6550—50 K unit). AJ has threaded bushings, sleeve bearings . . . AJS, servo mountings, sleeve bearings . . . AJSP, servo mountings, ball bearings. Many other features.*

THE Helipot CORPORATION
SOUTH PASADENA, CALIFORNIA

(Turn page for list of representatives)

* *See next two pages for complete mechanical and electrical details*

ELECTRICAL CHARACTERISTICS

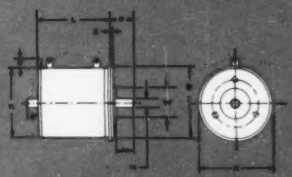
MODEL	A	AJ	
HELICAL TURNS	10	10	
RESISTANCE RANGE (OHMS)	10 TO 300,000	100 TO 50,000	
RESISTANCE TOLERANCE (ST'D)	±5%	±5%	
LINEARITY TOLERANCE (ST'D)	±0.5%	±0.5%	
BEST LINEARITY TOLERANCE	±.05% (above 20Ω)	±.1% (above 5KΩ)	
ELECTRICAL ROTATION	3600° +4° −0°	3600° +15° −0°	
MECHANICAL ROTATION	3600° +4° −0°	3600° +15° −0°	
POWER RATING (WATTS) (40° Ambient)	5	2	
COIL LENGTH (INCHES)	46.5	18.5	
NET WEIGHT (OUNCES)	4	1	

Technical Data for Helipot Potentiometers

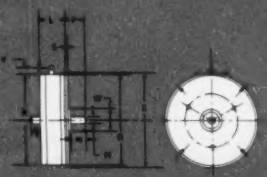
PHYSICAL DIMENSIONS (In Inches)

K	BODY DIAMETER	1.812	.750	
L	Body Length (To Front Mtg. Surface)	2	1.375	
M	Shaft Diameter	.2500 +.0000 −.0002	.1250 +.0000 −.0002	
N	Shaft Extension (Beyond Bushing) Front	.5	.375	
O	Shaft Extension (Beyond Bushing) Rear	.5	.375	
P	Shaft Extension (Beyond Mtg. Surf.) Front	.812	.687	
Q	Shaft Extension (Beyond Mtg. Surf.) Rear	.812	.375	
R	Mounting Shoulder Diameter	.4062 +.0000 −.0010	.281 +.000 −.002	
S	Mounting Shoulder Length	.125	.062	
U	Bushing Extension (Beyond Mtg. Surface)	.312	.312	
V	Height of Terminals (Above Body)	.312	.203	
W	Mounting Shoulder Diameter	—	—	
X	Lid Outer Diameter	—	—	
	THREADS	3/8-32	1/4-32	
	Number of Sections (Max.)	3	1	
	Add to "L" Dimension for each additional Section	—	0	
	Type Bearing	Sleeve	Sleeve	
	Starting Torque (Oz. In.)	2	.75	

A-AJ-B-EP-C-D-E-L



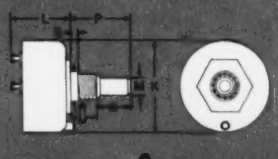
AJS-AH-BS-BEP-CH



J-LS-LEP-T

NOTES:

1. All locating lugs extend 1/16" beyond mounting surface.
2. Locating lugs on Models A, C and G are placed on a radius 9/16" from shaft centerline.
3. Locating holes on Models B, D, E and L are placed on a radius 17/32" from shaft centerline.
4. Three threaded 8-32 NC-2 x 3/32" deep equally spaced holes are provided on a 1.250 B.C. on Model AH, CH and J.
5. Terminals are marked as follows: C.C.W.—#1 . . . C.W.—#2 . . . Slider—S.
6. Tolerances on all decimal dimensions are ±.015".
7. Tolerances on all fractional dimensions are ±1/64".



AJS AJSP	AN	B BP	BS BSP	C	CN	D	E	G	J	L	LS	LSP	T
10	10	15	15	3	3	25	40	1	1	1	1	1	1
100 TO 50,000	100 TO 250,000	50 TO 500,000	50 TO 500,000	5 TO 50,000	30 TO 75,000	100 TO 750,000	200 TO 1,000,000	5 TO 20,000	50 TO 50,000	10 TO 100,000	10 TO 100,000	10 TO 100,000	1000 TO 100,000
±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%	±.5%
±0.5%	—	±0.5%	—	±0.5%	—	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
±.1% (above 5K)	±.025% (above 5K)	±.025% (above 18K)	±.025% (above 18K)	±.1% (above 5K)	±.05% (above 30K)	±.025% (above 75K)	±.02% (above 1M)	±.25% (above 5K)	±.15% (above 10K)	±.1% (above 24K)	±.1% (above 24K)	±.1% (above 24K)	±.25% (above 30K)
3600° +.125° −0°	3600° +.5° −.5°	5400° +.5° −.5°	5400° +.5° −.5°	1080° +.5° −.5°	1080° +.5° −.5°	9000° +.5° −.5°	14,400° +.5° −.5°	356°±2°	357°±1°	358°±1°	358°±1°	358°±1°	355° +.5° −.5°
3600° +.125° −0°	3600° +.5° −.5°	5400° +.5° −.5°	5400° +.5° −.5°	1080° +.5° −.5°	1080° +.5° −.5°	9000° +.5° −.5°	14,400° +.5° −.5°	360°	360°	360°	360°	360°	360°
2	5	10	10	3	3	15	20	2	5	5	5	5	2
18.5	46.5	140	135	14	14	234	374	3.1	5.0	8.5	8.5	8.5	2
1	4	13	13	2	2.5	17	21	2	4	8	8	8	.56

.750	1.820	3.312	3.328	1.812	1.820	3.312	3.312	1.312	2	3.000	3.000	3.000	.875
1.516	1.969	2.828	2.938	1.141	1.094	4.140	6.015	.891	1.032	.9375	.875	.875	.781
.1247 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2500 +.0005 −.0005	2497 +.0005 −.0005	2497 +.0005 −.0005	2497 +.0005 −.0005	.9780 +.0005 −.0005
.313	.5	1	.875	.5	.5	1	1	.5	.5	1	.5	.5	.25
.375	—	.5	—	.5	—	.5	5	None	.5	.5	.5	.5	.25
.375	.625	1.5	1	.812	.625	1.5	1.5	.875	.625	1.5	.625	.625	.312
.375	—	1	—	.812	—	1	1	None	.5	.5	.5	.5	.25
.625 +.005 −.001	1.875 +.005 −.001	.5437 +.0005 −.0015	.750 +.005 −.001	.4062 +.0005 −.0015	1.875 +.005 −.001	.5937 +.0005 −.0015	.5937 +.0005 −.0015	.4062 +.0005 −.0015	1.875 +.005 −.001	.5937 +.0005 −.0015	3.000 +.005 −.001	3.000 +.005 −.001	.7500 +.0005 −.0005
.062	.062	.125	.125	.125	.062	.125	.125	.125	.062	.125	.062	.062	.062
0	0	.5	0	.312	0	.5	.5	.375	0	.5	0	0	0
.203	.281	.265	.281	.312	.281	.265	.265	0	.250	.203	.203	.203	.156
—	.750 +.005 −.001	—	—	—	.750 +.005 −.001	—	—	—	.750 +.005 −.001	—	.750 +.005 −.001	.750 +.005 −.001	—
.750	2	—	3.5	—	2	—	—	—	2	—	3.125	3.125	.875
Flange	Flange	½-32	Flange	⅜-32	Flange	½-32	½-32	⅜-32	Flange	½-32	Flange	Flange	Flange
1	2	3	3	3	2	1	1	1	8	8	8	8	4
0	1⅝	—	2½	—	1	0	0	0	11/16	½	½	½	½
AJS—Sleeve AJSP—Ball	Ball Bearings	B—Sleeve BP—Ball	BS—Sleeve BSP—Ball	Sleeve	Ball Bearings	Sleeve	Sleeve	Sleeve	Ball Bearings	Sleeve	Sleeve	Ball Bearings	Ball Bearings
.75	1.0	B—2.75 BP—.75	BS—2.75 BSP—.75	1.75	1.0	3.5	4.5	.75	1.0	1.75	1.75	1.50	885 min. 215 lbs.

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The same engineering know-how and precision manufacturing facilities that have made HELIPOT the world's largest manufacturer of multi-turn potentiometers, have also established its leadership in the design and production of high precision *single*-turn potentiometers. These single-turn units are built with the same infinite care . . . on the same types of specially-designed equipment . . . by the same highly trained personnel that have made Helipot multi-turn potentiometers the world's standard. *Result*—a wide selection of single-turn potentiometers, available in volume, built to the highest-possible standards—*at mass-production economies!*

Most of the units shown at right are readily adaptable to special requirements—servo mountings, ball or sleeve bearings, ganged assemblies, single or double shaft extensions, taps spot-welded to a *single* turn of winding at virtually any desired point, and many other optional features to meet the needs of *your* applications.

So, no matter what your requirement in precision potentiometers, bring it to Helipot!

ADVANCED ENGINEERING! VOLUME PRODUCTION!

MODEL L SERIES (3" DIA.):
A high-precision single-turn unit with continuous mechanical rotation and minimum electrical dead space. Model L has bushing mounting, sleeve bearings . . . LS, servo mounting, sleeve bearings . . . LSP servo mounting, ball bearings. All are gangable to 8 sections, sections phasable after assembly to within ±1°. Many other features.*

MODEL J (2" DIA.):
The first production designed potentiometer with ball bearings as a standard feature—also versatile three-way servo mounting. Individual sections can be easily ganged and independently phased by the user after installation without external brackets or clamps. Many other unique features.*

MODEL G (1 5/16" DIA.):
A compact, single-turn precision potentiometer—low in price, extra rugged. Developed initially for remote positioning and indicating in aircraft applications—now also used for general instrumentation and servo mechanisms. Continuous 360° rotation. In certain resistance values is excellent for high temperature applications—at ambient temperatures as high as 165°C. under certain conditions.*

miniature

MODEL 7 "MITTORQUE" (7/8" DIA.):
A miniature ultra-low-torque unit for guided missiles and aviation electronics. Features shielded ball bearings, highest possible precision and quality, long life, rugged dependability. Length only 25/32"—weight only 0.36 oz.—starting torque only 0.005 oz. in., when specified—negligible running torque. Sliders phasable to within 3°. On vibration tests units have successfully withstood frequencies 0 to 2000 c.p.s. in 3 planes, accelerations up to 20 G's for periods to 1 hr.*

**See preceding pages for complete electrical and mechanical data.*

Duodials *for every application*

Duodial turns-indicating knob-dials are ideal for Helipots and other multi-turn applications. Available in a wide range of sizes and turns ratios . . .

MODEL RA:
The beautiful new 10 turn *Precision Duodial* (1-13/16" dia.) with a "feel" and appearance that add distinction to the finest instrument panels. Features excellent readability, positive locking lever, easy assembly. Available in 10:1 ratio only.

MODEL R:
Standard 2" Duodial in 10:1, 15:1, 25:1, 40:1 turns ratios for various Helipot ranges. Locking device, if desired.

MODEL W:
Large 4¼" Duodial for primary control applications. Easy to adjust and read. Finger hole for rapid rotation. Available in turns ratios of 10:1, 15:1, 25:1, 40:1.

THE LABORATORY HELIPOT (MODEL T-10A):

A 10 turn Helipot, "RA" Duodial and 3-way binding posts combined in a handsome walnut-cased unit ideal for laboratory and instruction purposes. Simplifies making and changing experimental circuits. More compact and 5 times faster to set than decade boxes. Linearity 0.1%, Power Rating 5 watts, Standard Resistance Ranges 100 to 100,000 ohms—others on order.

See preceding page for nearest representative

THE Helipot CORPORATION
SOUTH PASADENA, CALIFORNIA

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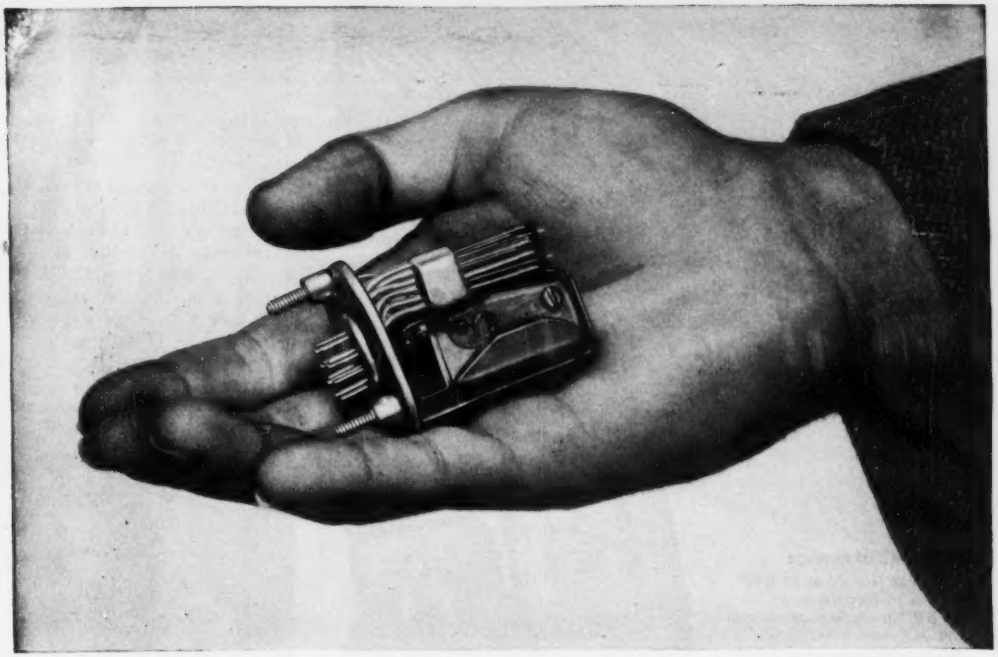


New G-E Relay Doubles Tip Pressure

Hermetically-sealed unit has larger magnet, no extra weight

Double the average tip pressure, 40-55 grams, is delivered by the larger magnet structure of the new G-E relay without exceeding Air Force-Navy specifications for size and weight.

The new relay, the first specifically designed for hermetic sealing, will withstand 50g operational shocks and instantaneous voltage surges up to 1500 volts rms *without failure*.

LONGER RELAY LIFE

The large magnet, polyester stack insulation, and silver-tipped contacts assure reliable, long-lived operation in aircraft, shipboard, portable land-based equipment and other systems which must meet Air Force-Navy specifications.

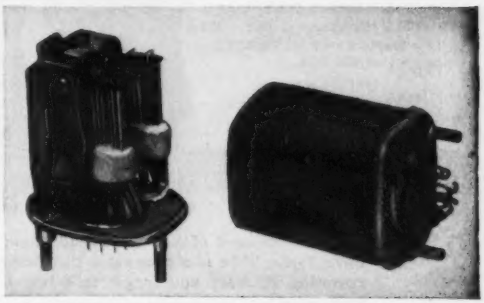
In every way, this new G-E relay is in a world of its own—sealed in a standard size enclosure against dirt, salt spray, high humidity, and widely varying air pressures.

RELIABLE SHIPMENT

This new device is now in full production and shipment can be made to meet your schedules.

Ask your nearest G-E office for more information, and send the attached coupon today. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC



THE LARGER MAGNET is made possible by an exclusive G-E design which utilizes the relay housing for structural support, thus eliminating much of the weight of internal bracing.

General Electric Company
Section B730-41
Schenectady 5, New York

Gentlemen:

I would like __ copies of Bulletin GEA-5729 on hermetically-sealed relays for:

_____ reference only **_____ an immediate project**

Name ..... **Title** .....

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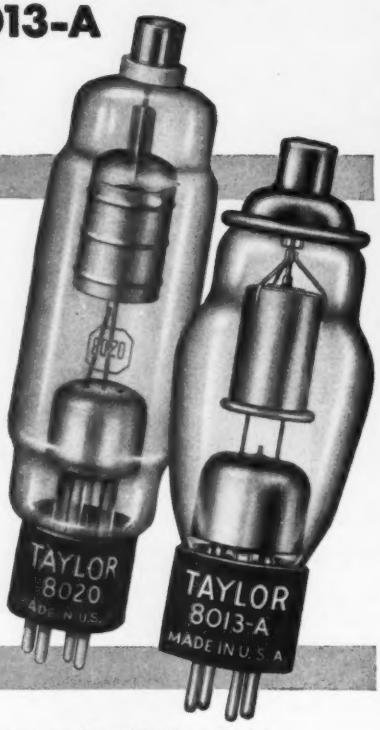
Top Performers
...in air...or oil

TAYLOR

8020 and 8013-A

HIGH VOLTAGE RECTIFIERS



Taylor 8020 Ratings
The 8020 is rated at 40 KVP inverse or forward in air, 60 KVP in oil. Average current: 100 MA, with instantaneous peak current capacity of 2 Amp.

Taylor 8013-A Ratings
The 8013-A is rated at 40 KVP inverse or forward in air, 55 KVP in oil. Average current: 20 MA continuous in air —30 MA continuous in oil; with instantaneous peak current capacity of 450 MA.

The extra measure of care and consideration afforded *every* Taylor Tube is a plus value that means greater operating efficiency and longer tube life. It's worth looking into.

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Cable: NATVARNCO

the space between the core and the jacket is filled with a compressed insulating material with high dielectric constant. Total volume of the wire capacitor is about 30 cubic mm.

The narrow space between the core and the jacket is filled with the insulating material in such a way as to make it highly uniform throughout. The basic material for the production of drawn capacitors is a copper tube 20-cm long, with outer diameter of 20 mm and a wall thickness of 2 mm.

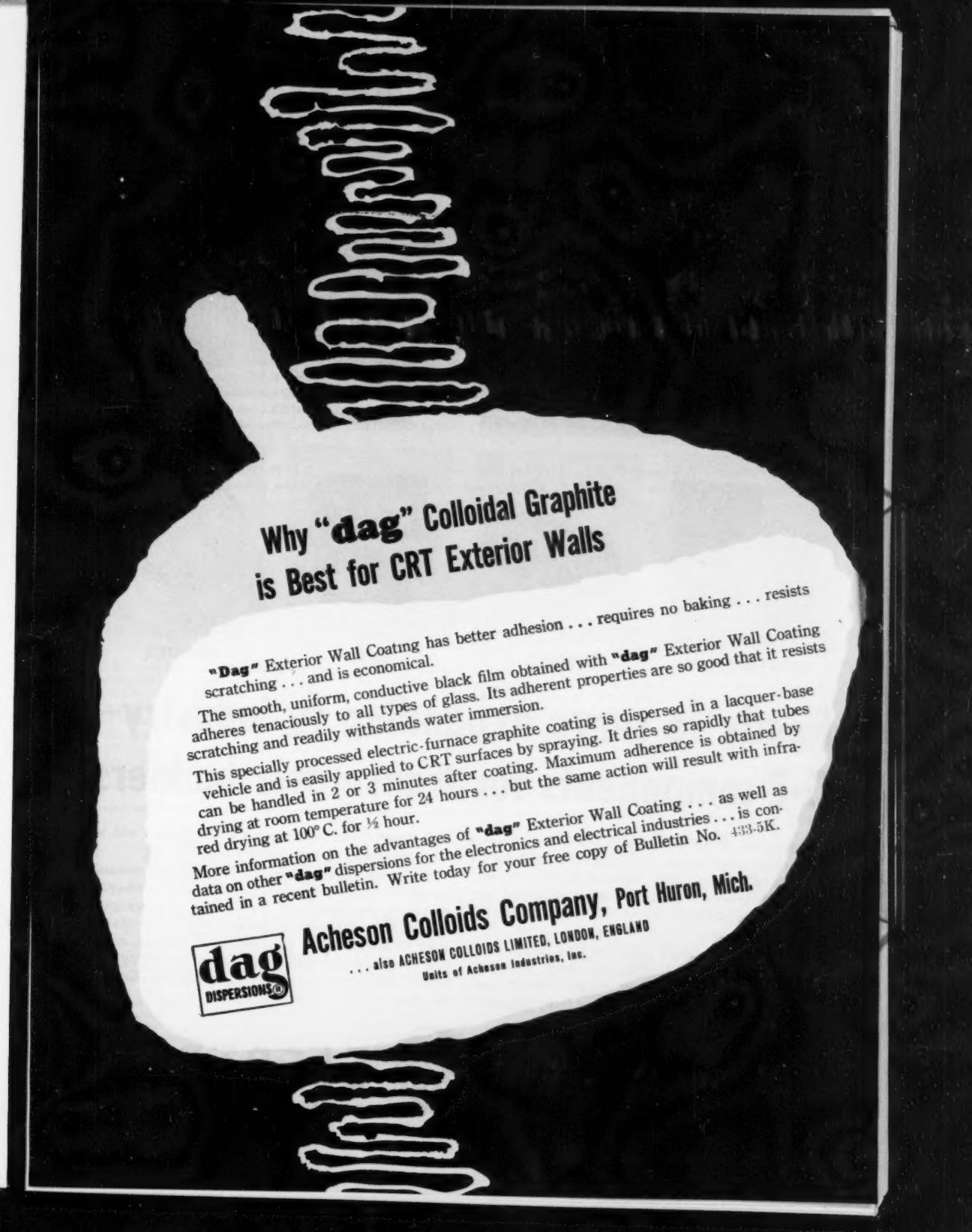
Photograph illustrating the small size of the wire capacitor

A wire core about 8 mm thick is inserted in the tube and centered with the aid of two rings acting as jigs. The annular space is filled with insulating material in powder form which is stamped in. The whole piece is then hammered and drawn out to a wire of about 40 meters and of a diameter slightly less than 1 mm.

The drawn wire is divided into pieces of the desired length and at one end of each piece, the jacket and insulation are removed to leave the core bare. Connecting wires are soldered onto the bare end of the core and onto the jacket.

Manufacturing Details

When dividing the 40-meter wire there must not be any short-circuiting between the inner and outer conductors. Since the jacket always bends somewhat outward when being broken, there is not much danger of a short circuit developing. The insulating material is packed so firmly between the core and the


Why "dag" Colloidal Graphite
is Best for CRT Exterior Walls
"Dag" Exterior Wall Coating has better adhesion . . . requires no baking . . . resists scratching . . . and is economical.
The smooth, uniform, conductive black film obtained with "dag" Exterior Wall Coating adheres tenaciously to all types of glass. Its adherent properties are so good that it resists scratching and readily withstands water immersion.
This specially processed electric-furnace graphite coating is dispersed in a lacquer-base vehicle and is easily applied to CRT surfaces by spraying. It dries so rapidly that tubes can be handled in 2 or 3 minutes after coating. Maximum adherence is obtained by drying at room temperature for 24 hours . . . but the same action will result with infrared drying at 100° C. for ½ hour.
More information on the advantages of "dag" Exterior Wall Coating . . . as well as data on other "dag" dispersions for the electronics and electrical industries . . . is contained in a recent bulletin. Write today for your free copy of Bulletin No. 433-5K.
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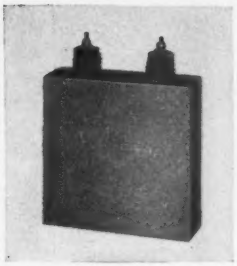
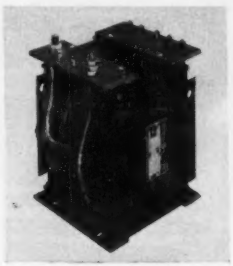
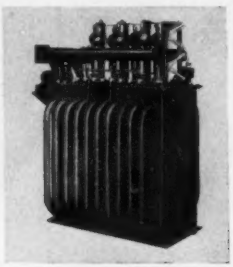


CAPACITORS

METERS AND INSTRUMENTS

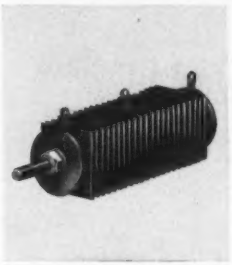


TRANSFORMERS

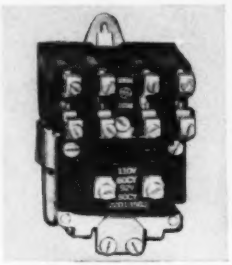


POWER SUPPLIES

VOLTAGE REGULATORS



RECTIFIERS



CONTROL

AMPLISTATS

Ready to serve expanding tv industry— G-E components for transmitter builders

Recent lifting of the freeze on new television stations has created many design and production problems for transmitter manufacturers. General Electric is ready to help designers solve one of these problems by providing a dependable supply of reliable, long-life electrical components.

To avoid costly delays, G.E. will plan output of its ample manufacturing facilities to match your production schedules. And recent design improvements and important new products resulting from continuing G-E research and development activities will add to the performance of your equipment.

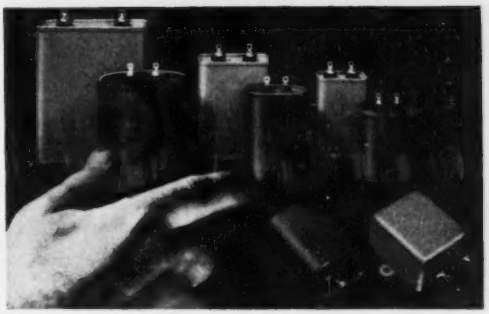
If you are engaged in supplying the huge demand for new tv station equipment, you'll find it worthwhile time-wise, cost-wise, and quality-wise to investigate the full line of applicable General Electric products. Your G-E Apparatus Sales Engineer has the story. Get in touch with him today, or write, giving full details and quantities involved, to General Electric Co., Sect. 667-22, Schenectady 5, N. Y.

GENERAL ELECTRIC

DIGEST

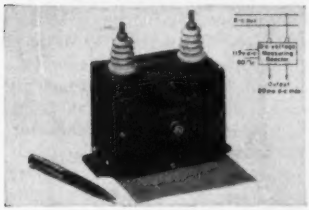
TIMELY HIGHLIGHTS ON G-E COMPONENTS

New drawn-oval capacitors are 10 to 20% lower priced



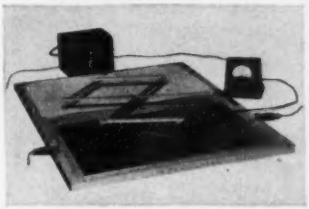
Here's a new line of General Electric capacitors for electronic applications, housed in drawn-oval containers, that features size reductions up to 30 per cent and cost reduction up to 20 percent! These fixed paper-dielectric capacitors also weigh less and are mechanically stronger than conventional types because of the drawn-steel container's single seam, hermetically sealed by double rolling. What's more, shipments are shorter. Designed to replace case styles CP70 and CP53, the new units are available in ratings from 2.0 muf to 10.0 muf, 600 to 1500 volts d-c and 330 to 660 volts a-c. See Bulletin GEA-5777.

New G-E reactor makes d-c voltage measurement safer



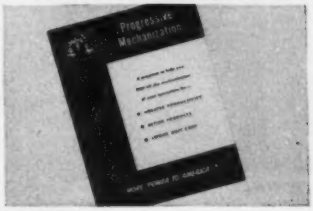
G.E.'s new d-c voltage measuring reactor minimizes hazard to personnel and equipment by isolating the instrument circuit from the d-c power source when making d-c voltage measurements. Since special safety precautions are not necessary, instrumentation costs are reduced. Available in six models for measurements up to 1200 volts. For complete application information, check Bulletin GEC-898.

New analog field plotter simplifies field studies



Electronics equipment engineers will find the General Electric analog field plotter a valuable aid in design work. Comprising plotting board and associated electric equipment, it speeds solution to problems such as electrode shapes in electronic tube design, field patterns in wave guides and electron lenses. Accompanying 50-page manual explains operation. See Bulletin GEC-851.

New G-E program boosts electronics in industry



"Progressive Mechanization," a new G-E More Power to America program, has just been launched. Consisting of a color movie and an authoritative manual, its aim is to help step up industry's mechanization. One expected result is an expansion of the market for electronic controls. For details on this program which may mean added business for you, check Bulletin GEA-5789.

EQUIPMENT FOR ELECTRONICS MANUFACTURERS

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- Demagnetizers

*Reg. Trade-mark of General Electric Co.

General Electric Company, Section A667-22
Schenectady 5, New York

Please send me the following bulletins:

Indicate: √ for reference only
X for planning an immediate project

- ☐ GEA-5777 Drawn-Oval Capacitors
- ☐ GEA-5789 Progressive Mechanization
- ☐ GEC-851 Analog Field Plotter
- ☐ GEC-898 DC Voltage-Measuring Reactor

Name.....

Company.....

City.....State.....

Maybe you've noticed how much of today's best equipment uses

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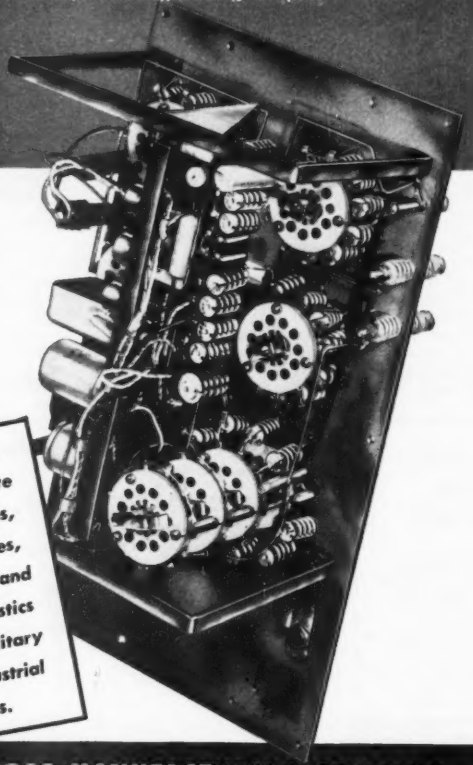
WIRE-WOUND RESISTORS

Accuracy from ±1.0% to 0.01% as required



The largest, most complete line of types, shapes, sizes, mountings and characteristics for all military and industrial uses.

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Collingdale, Pa.

jacket that there is no possibility of any of it falling out of the capacitor along the plane of rupture.

To bring about electrical contact with the inner conductor, the jacket and the insulation have to be removed over part of the length of the capacitor. This affords an opportunity to give the capacitor exactly the desired value by removing just as much of the jacket as necessary to reach the particular value of capacitance.

In practice, the jacket is removed by electrolytic etching with the jacket serving as anode. One hundred of the capacitors at a time are immersed in the etching bath to a depth corresponding to the length of jacket to be removed. A voltage is then applied between all the jackets and an electrode placed in the bath.

The current passing through the bath is continuously controlled. By the time the metal of the jacket has dissolved, the current has dropped practically to zero. The inner conductor of the capacitor cannot act as an electrode because it is insulated from the outer conductor. The insulating material is so firmly compressed during the drawing process that after the outer jacket has been etched off, it does not of itself break away from the inner conductor but has to be removed separately. After the etching proc-

Wire capacitor as used in an i-f transformer. The capacitor may be seen on the left and right sides

TYPE "SNAPPER"

THERMAL TIME DELAY RELAY

FEATURES . . .

Snap action. Small size. Light weight. Low operating temperature. Operates in any position. High contact rating. Gas filled. Consistent timing. Mechanical structure insures durability and long life.

"TEST AFTER TEST IT'S THE BEST"
EUREKA PRESENTS
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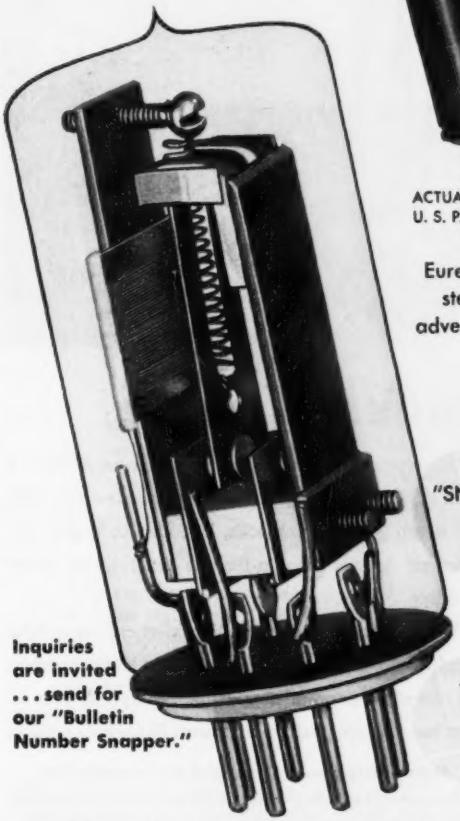

Inquiries are invited . . . send for our "Bulletin Number Snapper."

Eureka's "SNAPPER" incorporates the most radical forward step in the history of THERMAL TIME DELAY RELAYS with the advent of "POSITIVE SNAP ACTION". . . With this action the ELIMINATION OF CHATTERING is accomplished . . . The various uses for a THERMAL TIME DELAY RELAY have been increased manifold with the incorporation of a "SINGLE POLE DOUBLE THROW" feature. Due to its versatility, the "SNAPPER" relay can be manufactured to suit required needs.

VOLTAGE: 6.3, 26.5 and 115 volts (A.C. or D.C.) or as required. AMBIENT TEMPERATURE RANGE: $-60°$C. to $+80°$C. ENVELOPE: Miniature, or octal metal; glass upon request. All have identical operating characteristics.
TIME DELAY PERIODS: Preset from 2½ seconds and up.
VACUUM: Evacuated, inert gas filled producing an arc quenching atmosphere.
HEIGHT: 1¾" max. seated.

EUREKA TELEVISION AND TUBE CORPORATION

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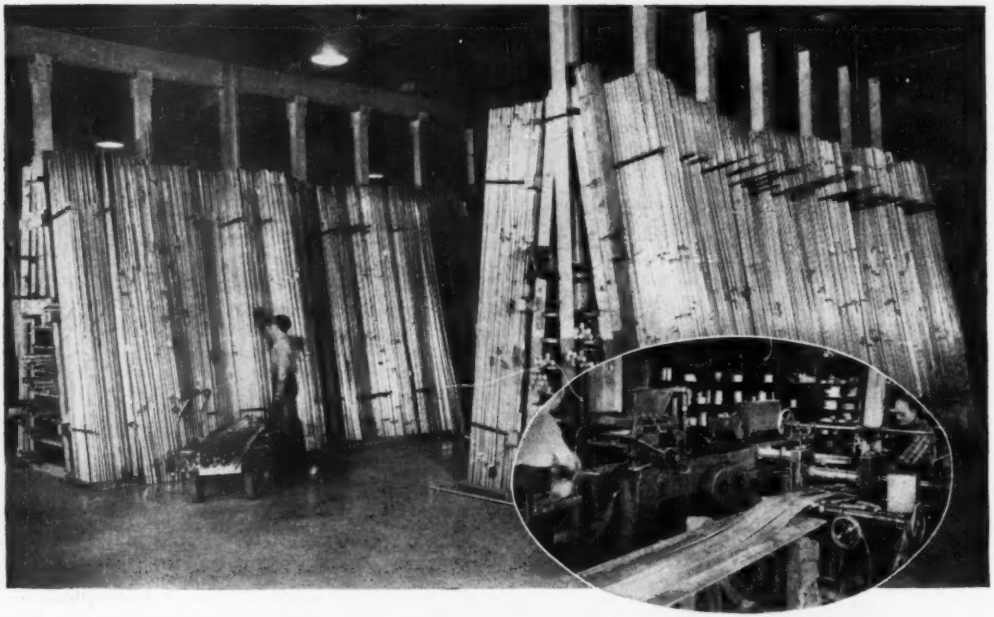
OFFICES AND WAREHOUSES IN PRINCIPAL CITIES



BRIDGEPORT WAREHOUSE SERVICE

The Bridgeport warehouses are designed to supply from stock limited quantities of sheet, rod, wire or tubing. It is the policy of the company to maintain adequate warehouse stocks at all times so that small orders can be filled without delay.

The fabricator is in a position to obtain promptly metal to fill orders for experimental work or to start production runs, while waiting for mill shipments.

Bridgeport warehouses make every effort to carry the variety of alloys, sizes and gages which fulfill the requirements of the locality they serve.

To take care of the maximum range of widths of strip metal, slitting service is available—not only to serve warehouse stocks, but also to make customers' stocks of non-ferrous strip metal more flexible.

Bridgeport's Warehouse Stocklist carries weight tables and a technical digest giving the properties of the most popular copper-base alloys. If you do not have a copy, ask your nearest Bridgeport office.

Mills in Bridgeport, Conn. and Indianapolis, Ind.
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Bridgeport

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HERMETICALLY SEALED
Diameter.....3/16" to 1-1/4"
Length.....9/16" to 10"
Current: half-wave..1.5 ma to 60 ma
Voltage: DC output.....20 volts to 4,000 volts

PHENOLIC CARTRIDGE
Diameter.....⅛" to 1"
Length.....½" to 12"
Current: half-wave..1.5 ma to 60 ma
Voltage: DC output....20 volts to 10,000 volts

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EL SEGUNDO CALIFORNIA

SELENIUM DIODES
Diameter.....0.100" to 0.300"
Length.....0.210" to 0.250"
Output Voltage.....20V to 80V
Output Current...20 ua to 1.5 ma
Temperature Range -50°C to 100°C

Selenium Rectifiers

A recent month's production included Rectifiers to supply 40 microamperes, 1,000 volts, and Rectifiers with a capacity of 140,000 amperes, 14 volts.

POWER STACK
30 Kw Power
Considered to be the largest single selenium rectifier stack produced.

Owned and managed by Engineers who are specialists in the design and manufacture of Selenium Rectifiers. Submit your problems for analysis and we will be glad to offer our recommendations.

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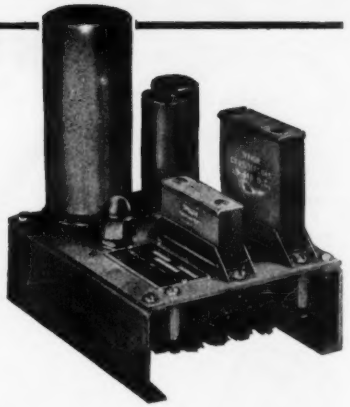

CALIBRATED AGAINST A STANDARD ACCURATE TO 1 PART IN 10-MILLION

The basic unit of this frequency standard is an electronically driven fork,—temperature compensated and hermetically sealed against changes of humidity and barometric pressure. Through its use, any frequency or multi-frequencies between 40 and 20,000, fractional or otherwise, are obtainable.

FROM 40 TO 20,000 CYCLES

CONSERVATIVE ACCURACY UNDER USUAL CONDITIONS
1 PART IN 100,000—(.001%)

Have you a need for any specific number of cycles in precision frequencies?

Can a source of such frequency solve your design problem or increase its factor of safety?

Have you a system that requires great accuracy, stability and dependability?

The frequencies shown at the top of the page are but a few among hundreds furnished for precision application in industries, laboratories and Government departments.

OUR ENGINEERS ARE AVAILABLE TO COOPERATE ON ANY PROBLEM

American Time Products, Inc.

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ess, the capacitors are washed in water to remove any traces of the etching medium.

An entirely different method of removing the jacket is to shave it off with a lathe. For this purpose, a special lathe has been designed which is characterized by the fact that the cutter rotates while the capacitor is clamped close up against the cutter. The capacitor is centered in the lathe by means of a diamond cutting die, while a diamond cutter shaves off the jacket over the length necessary.

The capacitance is measured while the jacket is being shaved off and as soon as it reaches a value within the required tolerances, the rotating cutter is stopped automatically. By this shaving process, it is possible to reach a tolerance of 0.2 percent in capacitance. By the etching method the degree of accuracy is not as high.

Applications

The wire capacitor has been developed for use in i-f transformers consisting of two mutually magnetically coupled L-C circuits. The two coils are wound directly on a core of Ferroxcube, a ceramic material with high permeability. In these transformers, the small wire capacitors have replaced the large mica capacitors.

Simple high-frequency tuning circuits also are applicable for wire capacitors. These consist of a small coil with a movable Ferroxcube core and a wire capacitor. By screwing the core in or out of the coil, it is possible to vary the resonant frequency of the circuit. This device replaces the conventional tuning circuits built up from one or more coils and one or more variable capacitors.

Graphical Aids to Broadcasting

By A. E. Richmond

Consulting Engineer
Portland, Oregon

Although much graphical and tabular data have been published relative to the design of electronic equipment, the use of graphical information in the operation of equipment is not too common. Graphical operating devices have several advantages over the more

THE SIMPSON MODEL 260
VOLT-OHM-MILLIAMMETER

outsells all others combined

because . . .

A covers all ranges necessary for Radio and TV set testing
B includes the Simpson 50 Microampere Meter Movement known the world over for its ruggedness
C no bulky harness wiring, thus eliminating all intercircuit leakage at this high sensitivity
D molded recesses for resistors, batteries, etc.
E easy battery replacement
• all components—including case and panels—are specially designed and completely tooled for maximum utility . . . not merely assembled from stock parts

ranges *20,000 Ohms per Volt DC, 1,000 Ohms per Volt AC*
Volts, AC and DC: 2.5, 10, 50, 250, 1000, 5000
Output: 2.5, 10, 50, 250, 1000
Milliamperes, DC: 10, 100, 500
Microamperes, DC: 100
Amperes, DC: 10
Decibels (5 ranges): —12 to +55 DB
Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center)

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Model 260 $38.95; With Roll Top $46.90. Complete with test leads and operator's manual. 25,000 volt DC Probe for use with Model 260, $9.95.

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Sylvania provides highest quality electronic components for radio, television and other electronic equipment . . . at lowest prices.

New plant facilities and improved methods now enable Sylvania to provide you with highest quality electronic components for every need . . . *when you need them.*

Typical examples of Sylvania components include hundreds of diversified items such as: *Terminal Strips and Boards; JAN Sockets; Radio Tube, Cathode Ray Tube and Power Tube Sockets; Fuse Holders; Plugs and Connectors.*

To be sure of the finest possible quality . . . put your component problems up to Sylvania. We welcome your inquiries addressed to: Sylvania Electric Products Inc., Dept. A-1010. Warren, Pa.

SYLVANIA

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ONE Nichrome*

"One World." All over the globe, men have come to acknowledge this unique concept as the most effective basis for solving innumerable problems related to human progress.

"One Nichrome." All over the globe, men have come to acknowledge this unique alloy as the most effective means for solving a host of problems also related to human progress—in the fields of engineering and production.

This being so, we take particular pride in our trademark: NICHROME—granted solely and wholly to us by the United States Patent Office forty-three years ago. Representing a series of superb electrical heating and resistance alloys, developed and produced *only* by Driver-Harris, it symbolizes top quality and utmost dependability to manufacturers everywhere.

*T. M. Registered in United States Patent Office by Driver-Harris Company August, 1908

World-Famous **Nichrome*** is produced only by

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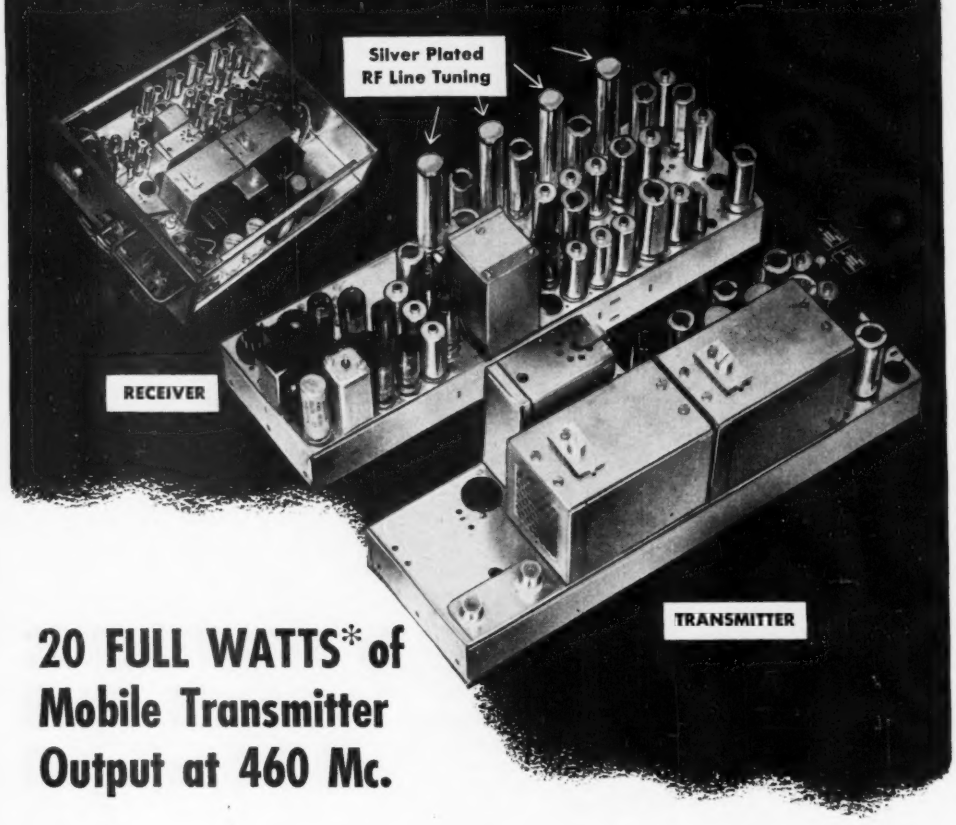

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Table 1—Operating Currents for Array of Fig. 1

Tower Number	Normal Current (amp)	Normal Ratio to Tower 1 Current
1	2.1	1
2	1.5	0.714
3	2.8	1.333

customary slide-rule or pencil-and-paper methods. In particular, the graphs are made especially for the job and can be made more accurate and convenient than other rapid methods.

As examples, this article presents two easily prepared aids to the broadcast-transmitter operator. The graphs are to be prepared individually for the particular values anticipated in each case.

Figure 1 shows a method of determining almost instantly whether or not the ratios of currents within a directional array are within their required five-percent tolerance. This sort of graph is especially useful where several towers are used, although to avoid confusion not more than about two other currents should be compared with the reference current on any one sheet. Figure 1 applies to an array having the normal operating currents given in Table I.

It is a simple matter to determine

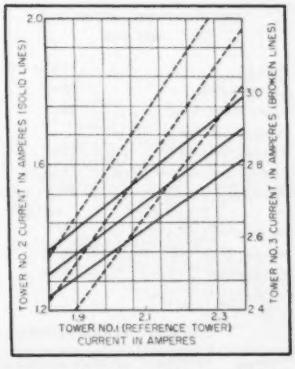
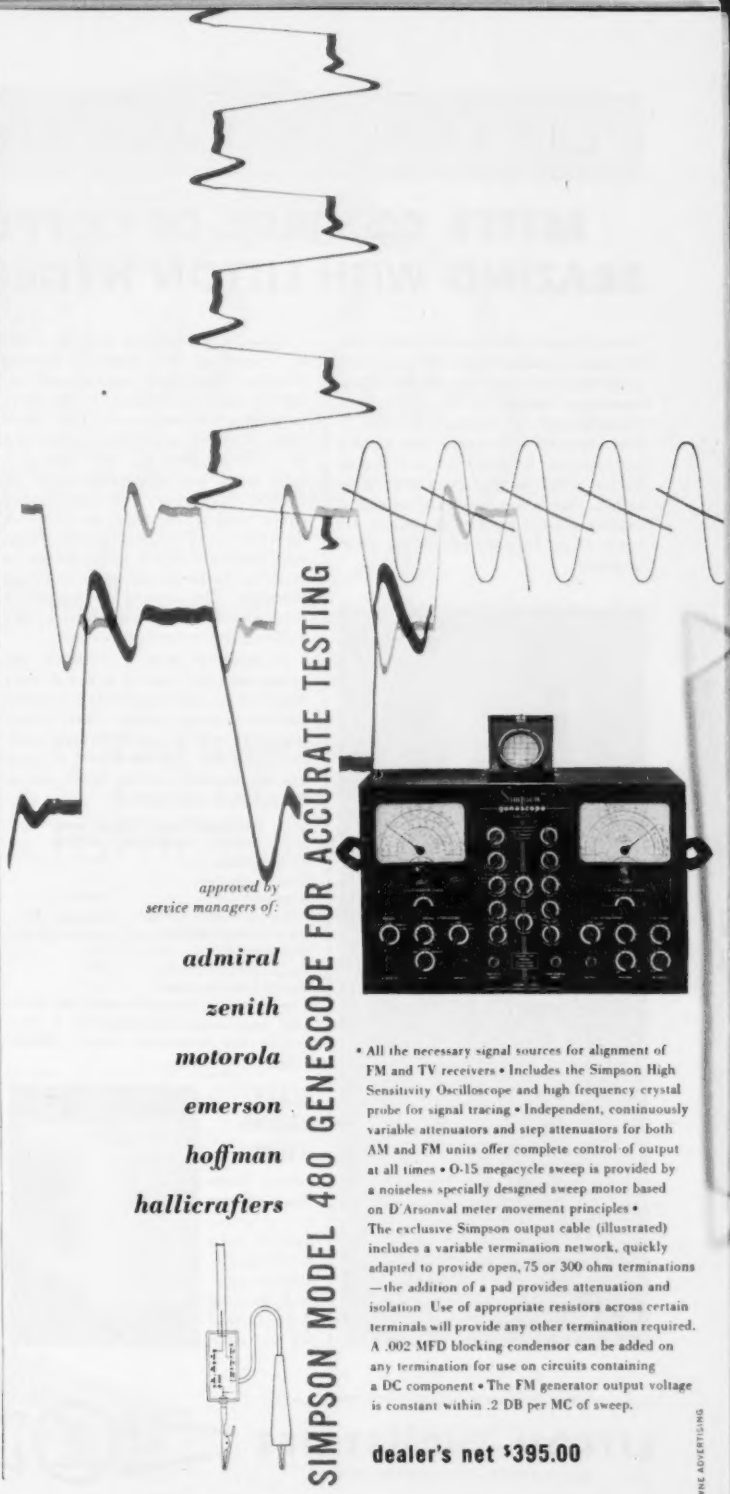


FIG. 1—Sample graph for checking ratios of currents in different towers of broadcast directional antenna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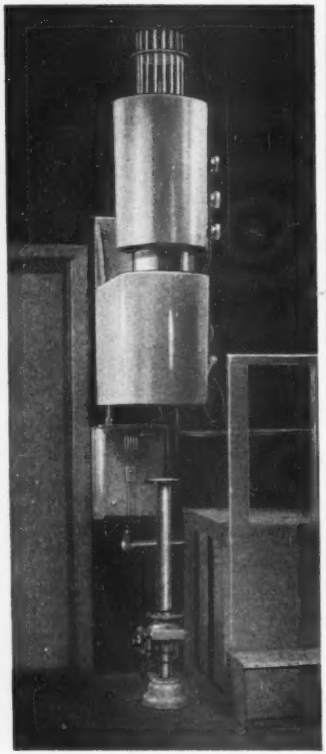
BETTER CONTROL OF COPPER OR ALLOY BRAZING WITH LITTON HYDROGEN FURNACE

Litton Model 4400 Vertical Hydrogen Furnace is designed for easily observed, accurately controlled production-line brazing of assemblies up to 6½" in diameter and 12" in length. Brazing is performed in a hydrogen atmosphere and work can be inserted into the open bottom either mechanically or hydraulically. Operating temperature range permits copper brazing as well as all types of gold-copper and silver alloy brazing.



Model 4400 Furnace is divided into two chambers. The upper or brazing chamber is equipped with radiant heating for maximum flexibility. The lower or cooling chamber permits rapid cooling to the freezing point of the metal or alloy. The heating chamber has an inconel inner wall surrounded by 3" of thermal insulation. Two replaceable pyrex windows permit a clear view of the work during the heating cycle. Tungsten heating rods are spring-loaded to preserve tautness, and may be easily replaced. The cooling chamber is a double-walled cylinder of stainless steel within which water is circulated.

In operation, work is raised into the upper chamber, heated at the desired rate or rates, and immediately lowered into the cooling chamber. Since power is applied only during the heating cycle (normally less than one-third of loading, heating and cooling time), power consumption is minimized.

SPECIFICATIONS—MODEL 4400 VERTICAL HYDROGEN FURNACE

Work diameter, max.	6½"
Work length, max.	12"
Temperature, max.	1250°C
Voltage to maintain 1250°C	Approx. 22v
Kva to maintain 1250°C	Approx. 23 kva
Overall height	75"
Overall diameter, heater	17"
Overall diameter, cooler	12"

Heater elements: 15 Tungsten rods, .050" dia. x 40" long, connected in parallel.

Time to raise furnace and work to 1000°C: Approx. 17 minutes.

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Litton Glass Baking Ovens are circular and easily mount in any exhaust position. Heating is by Calrod units and ovens are designed for continuous operation at 500°C. Oven models 2, 3 and 4 can be operated in either series or parallel. Ovens range from 5" to 12¾" in diameter, and 12" to 18" in length. Complete details and prices for all models will be supplied on request.

MODEL 5301 BELL JAR

For smaller brazing problems, Litton table-top Bell Jars offer maximum convenience and speed. Visibility through the all-glass jar simplifies alignment and positioning of the work. Vertical movement of the bell is lightened by a counterweight inside the supporting column. Work stand height is variable, and the heater rod can be adjusted and locked in position.

SPECIFICATIONS—MODEL 5301 BELL JAR

Base	11½" x 16½"
Column height	56¾"
Heater stand, height	23½"
Heater stand arm (extended length)	10⅝"
Heater stand, vertical travel	12"
Work stand extensions	2", 4", 6", 8" and 12"
Jar diameter	12"
Height	24"
Travel of jar	28½"

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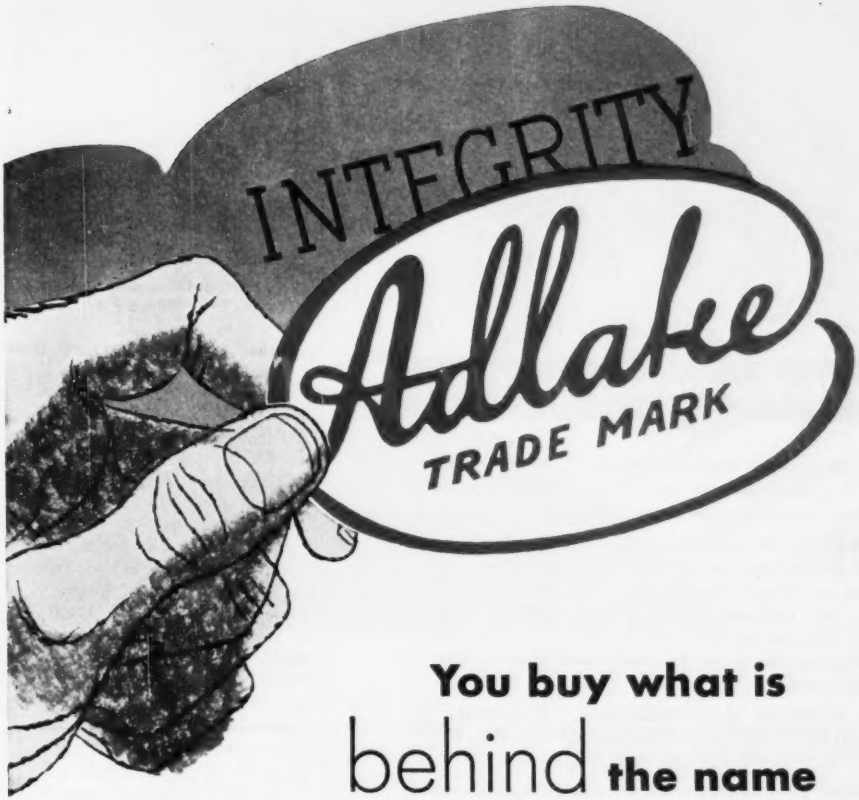

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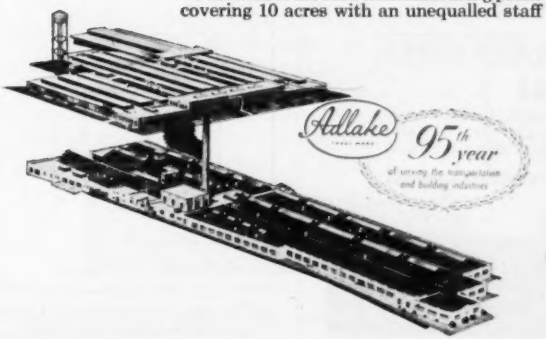

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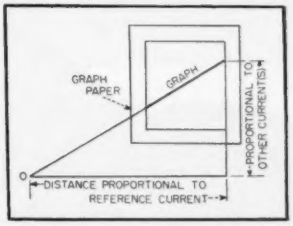

FIG. 2—Method of preparing graphs of type shown in Fig. 1

whether or not the currents have ratios within their tolerances if the reference current remains constant. With a graph of this kind, however, the operator is prepared to meet quickly the more probable situation wherein the reference current changes simultaneously with the other currents.

Figure 1 depends for its design upon the proportional relationships between the sides of similar triangles. Each graph is a segment of the hypotenuse of a right triangle, the base and altitude of which are proportional, respec-

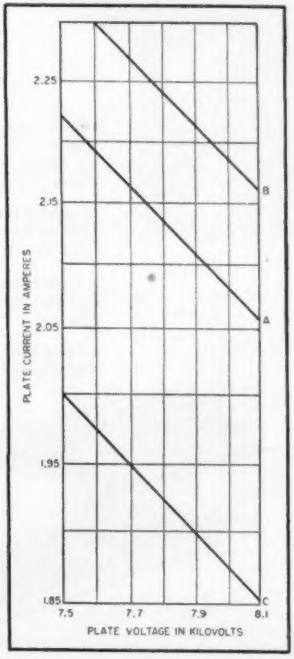

FIG. 3—Rapid determination of input power to transmitter final amplifier

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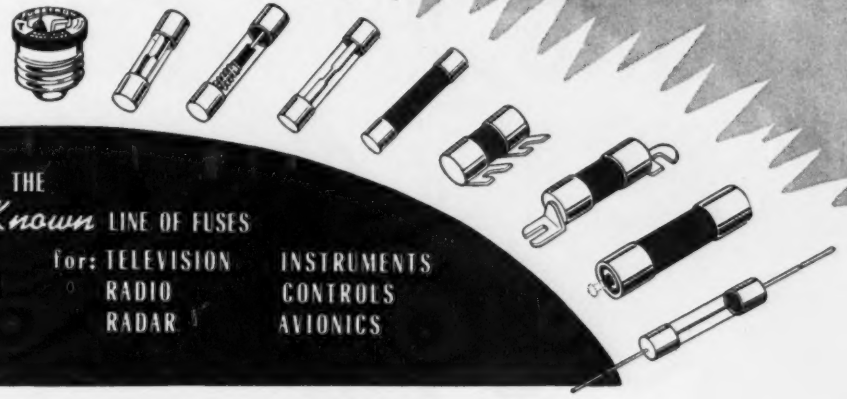

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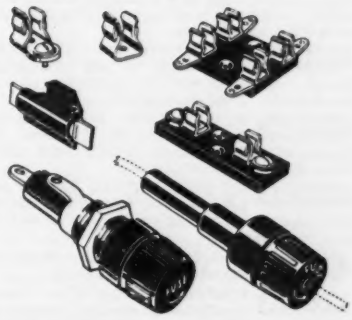

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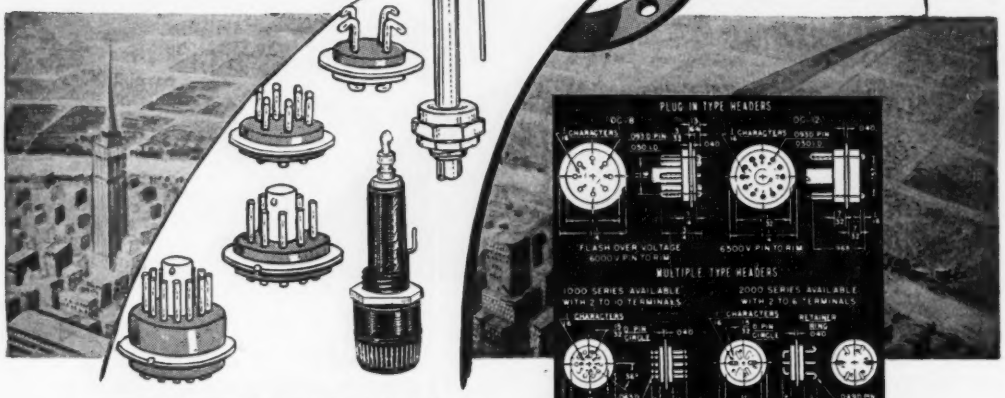

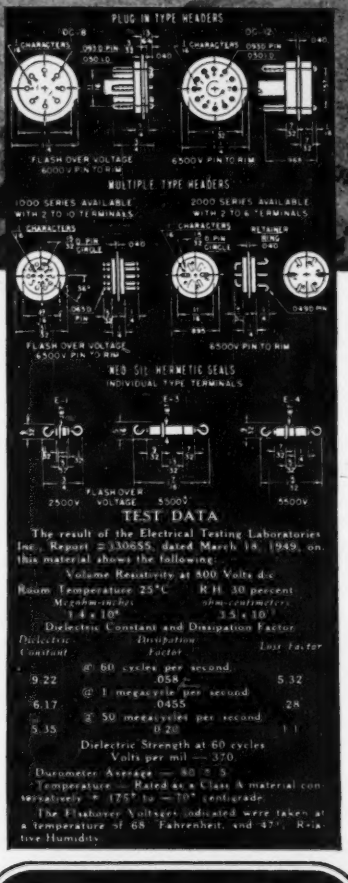
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Dielectric Constant and Dissipation Factor

Dielectric Constant	Dissipation Factor	Loss Factor
@ 60 cycles per second		
9.22	.058	5.32
@ 1 megacycle per second		
6.17	.0455	.28
@ 50 megacycles per second		
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 370

Durometer Average — 80 ± 5

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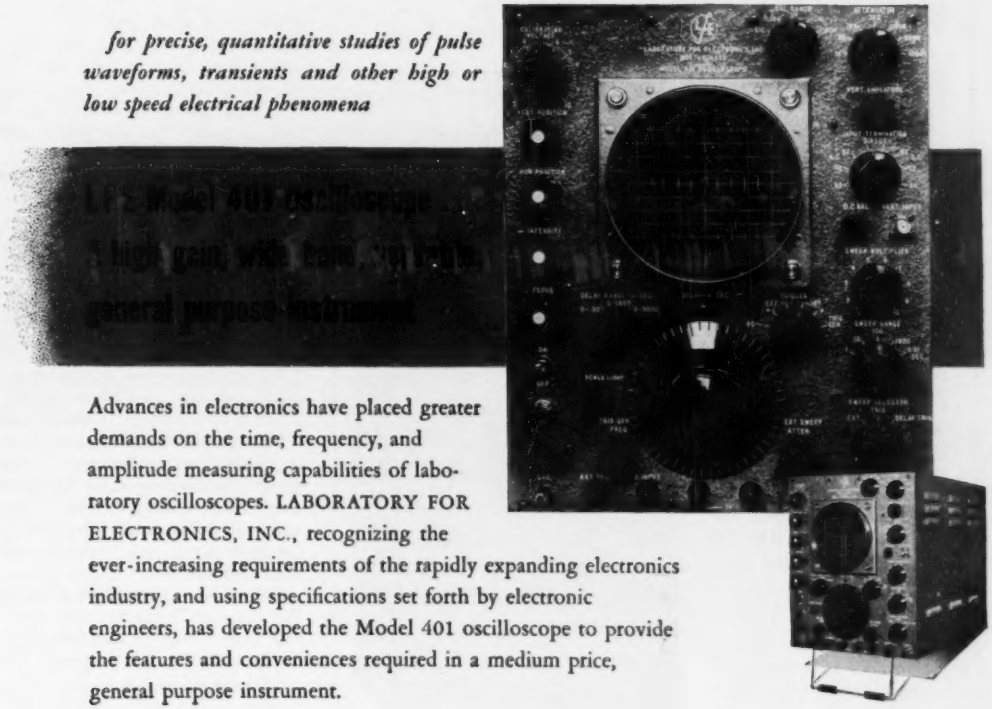

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302B Battery Operated	2 to 150,000 cycles	100 microvolts to 100 volts	2 megs. shunted by 8 mmfds. on high ranges and 15 mmfds. on low ranges	3% from 5 to 100,000 cycles; 5% elsewhere	$225.
305	Measures peak values of pulses as short as 3 microseconds with a repetition rate as low as 20 per sec. Also measures peak values for sine waves from 10 to 150,000 cps.	1 millivolt to 1000 volts Peak to Peak	Same as Model 302B	3% on sine waves 5% on pulses	$280.
310A	10 cycles to 2 megacycles	100 microvolts to 100 volts	Same as Model 302B	3% below 1 MC 5% above 1 MC	$235.
314	15 cycles to 6 megacycles	With probe, 1 millivolt to 1000 volts. Without probe, 100 microvolts to 1 millivolt	With probe, 11 megs. shunted by 6 mmfds. Without probe, 1 meg. shunted by 25 mmfds.	3% except 5% above 3 megacycles	$265

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tively, to the reference current and to the current being compared with it.

Figure 2 shows one way of preparing such graphs. The intermediate graph of each set indicates currents of precisely the proper ratio and the ±5 percent tolerances are indicated on the upper and lower graphs of the set.

Figure 3 is helpful in checking the operating power of transmitters, such as f-m or tv transmitters, using the indirect method of power measurement. The example shown would be suitable for use with a 10-kw f-m transmitter using an arbitrary efficiency figure of 60 percent. The normal plate voltage is about 7.8 kilovolts for the particular example chosen, and the current about 2.12 amperes. Current and voltage products falling upon graph *A* provide the specified power input, while those between the limits of graphs *B* and *C* are within the f-m transmitter temporary tolerances of 5-percent above and 10-percent below rated power.

The voltage and current scales of Fig. 3 are not linear but have intervals proportional to the logarithms of the quantites represented. In graphs for actual use, additional divisions of the scales will be convenient in both types shown.

Impulse Modulator

By HILARY MOSS
Chief Engineer
Electronic Tube Corp.
Philadelphia, Penn.

GENERATING amplitude-modulated waves which are substantially free from distortion at high modulation depths is far from easy. The classical plate-modulated class-C circuit is quite good but involves critical adjustments. This article describes a simple feedback method which gives excellent results and requires little adjustment.

Development of the method may be seen from Fig. 1. This shows the essentials of a perfect modulator. The switch *S* operates at the carrier frequency to which the secondary of T_1 is tuned. Assume that transformer T_2 has a perfect core material, then the whole network is linear and it follows that the am-

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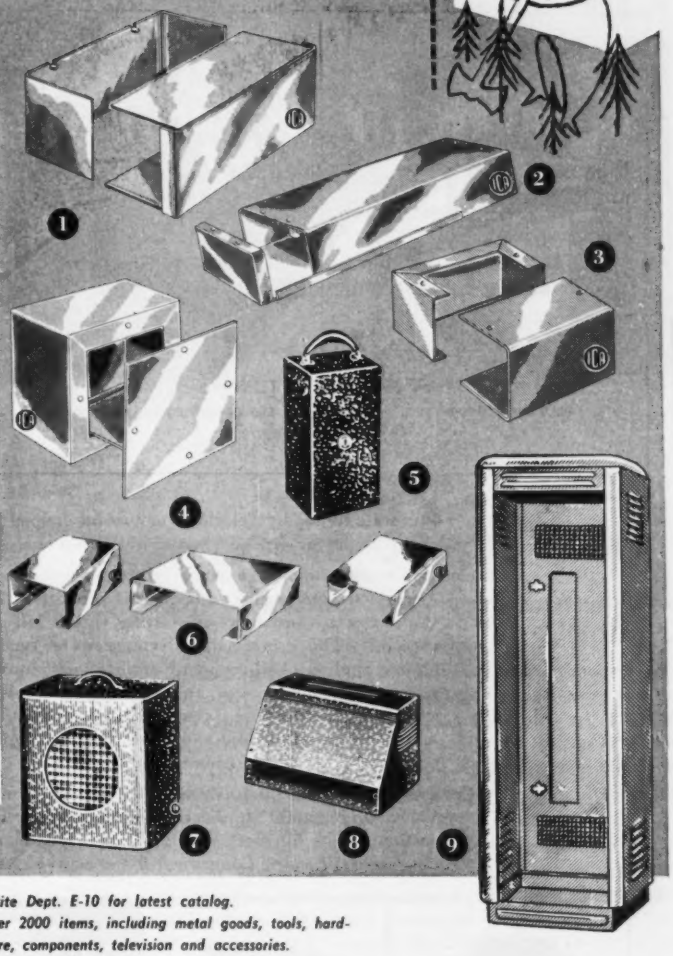

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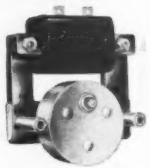

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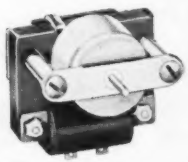

Type B3 Motor—A medium-duty motor that's ideal for washing machine timers, and other switching applications. Also recording and controlling mechanisms.

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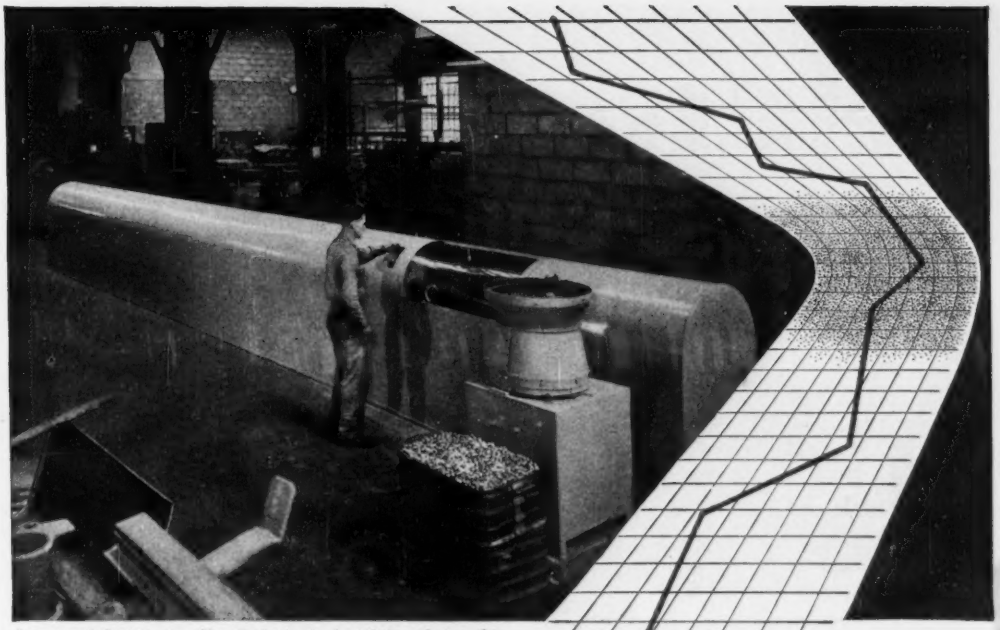

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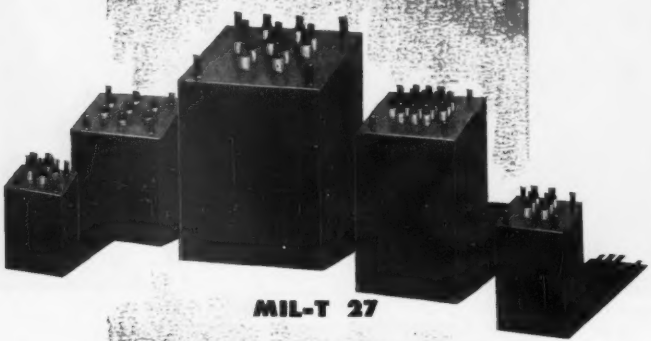

MIL-T 27

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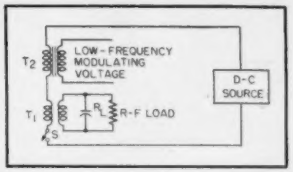


FIG. 1—Essential circuitry for a perfect modulator

plitude of the r-f voltage across the load R_L is an exact reproduction of the modulating voltage waveform. The mark/space ratio of the switch S is immaterial, provided it is constant.

It would seem profitable to try to simulate the network of Fig. 1 in the search for a perfect linear modulator. The problems of doing this are wholly associated with the switch S. The only form of switch having suitable frequency characteristics must be a thermionic tube. Since this is inherently a nonlinear device, the simplicity and perfection of Fig. 1 can not be entirely achieved.

Figure 2 shows a practical network to simulate that of Fig. 1. Tube V_1 is the off-on keyed tube replacing S. Its resistance when conducting is made low by connection of a low-valued resistor R_1 between the anode and control grid. Nonlinearities in the tube's conductance-voltage curve become relatively unimportant in comparison with the cathode resistor R_C. The capacitor C_1 which shunts R_C acts as a bypass only for the carrier frequency.

The turns ratio on T_1 is kept high so that the variation in back voltage across its primary is small and does not appreciably vary the resistance of V_1 during the conducting portion of its cycle. These details of operation will be quantitatively discussed elsewhere.

Tube V_2 is the keying tube which

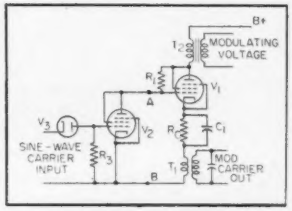
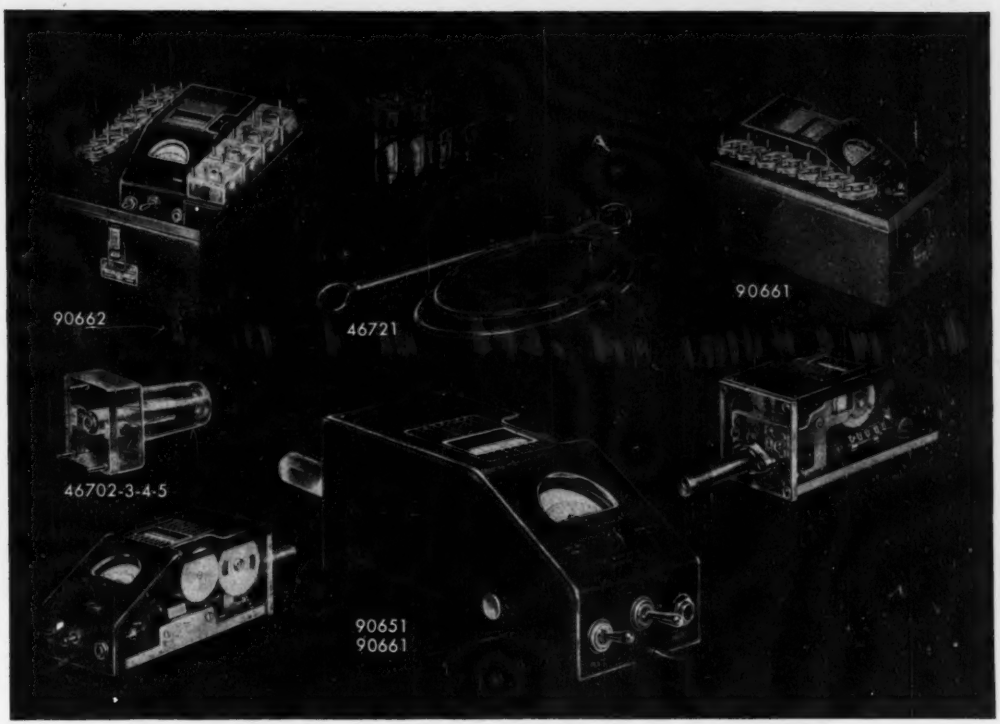


FIG. 2—Practical network simulating circuit of Fig. 1



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The 90661 Industrial Grid Dip Meter is similar to the 90662 except for a reduced range of 1.7 to 300 mc. It likewise incorporates the three wire grounding type cord and metal carrying case.

The 90651 Standard Grid Dip Meter is a somewhat less expensive version of the grid dip meter. The calibration while adequate for general usage is not as complete as in the case of the industrial model. It is supplied without grounding lead and without carrying case. The range is 1.7 to 300 mc. Extra inductors available extends range to 220 kc.

The Millen Grid Dip Meter is a calibrated stable RF oscillator unit with a meter to read grid current. The frequency determining coil is plugged into the unit so that it may be used as a probe.

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The Grid Dip Meters may be used as:

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2. An Oscillating Detector
3. A Signal Generator
4. An Indicating Absorption Wavemeter

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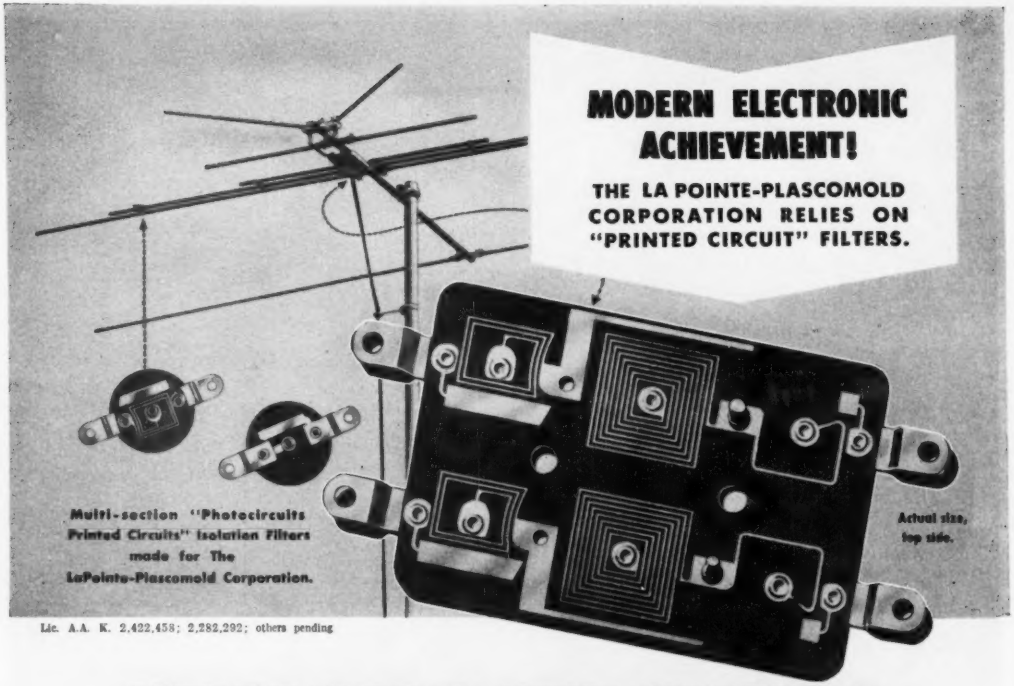
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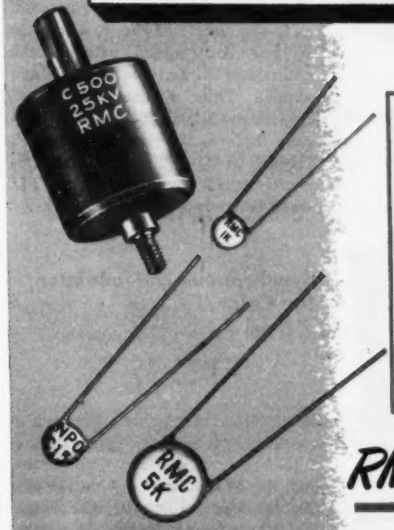

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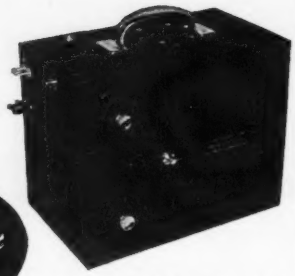

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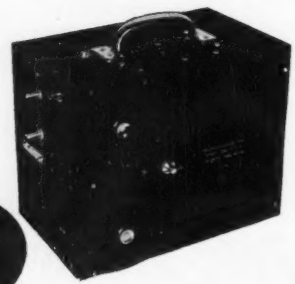

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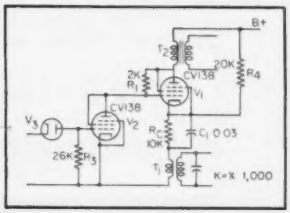

FIG. 3—Final circuit of the impulse modulator

is periodically made conducting by driving it from a large amplitude carrier source via diode V_2 and load R_3. This operation cyclically cuts off V_1 by joining A and B through an equivalent low resistor. The bias developed across C_1 cuts off V_1.

The network of Fig. 2 has one obvious weakness. At those portions of the modulation cycle when the anode potential on V_1 is low, V_2 operates over very nonlinear portions of its characteristic and one should expect nonlinearity in the output modulated wave. The circuit however, is quite good for modulation depths up to about 80 percent.

In the circuit of Fig. 3, a resistor R_4 has been added between the cathode of V_1 and the high-voltage supply. Thus, V_1 becomes cut off and the modulation reaches 100 percent before the potential of V_2 reaches zero. By making R_4 sufficiently small, the keying tube V_2 is made to operate almost linearly.

Synchronous Demodulator for Color TV

By Robert B. McGregor

Senior Design Engineer
Arvin Industries, Inc.
Chicago, Ill.

Much similarity exists between a black-and-white tv receiver and the NTSC color receiver. The front end, the i-f amplifier and the sweeps are the same. However, the video which is extracted by the second detector contains a subcarrier of 3.89 mc which carries the color information. Besides the standard video amplifiers, which may be called the monochrome channel, there is a channel which extracts the color information and then uses video amplification to put the color into the picture. This is called the chro-

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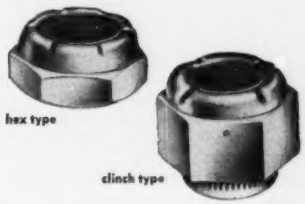

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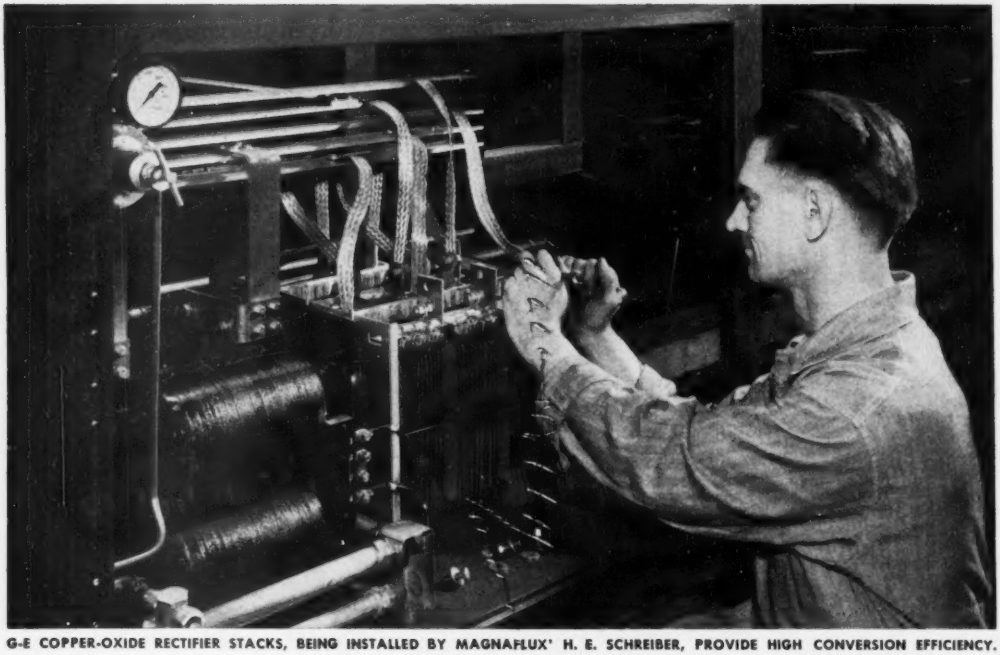

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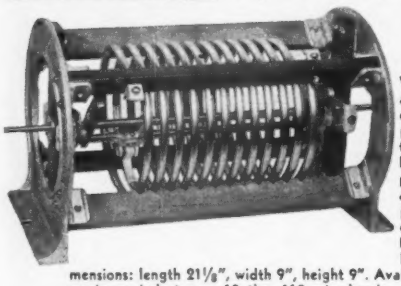

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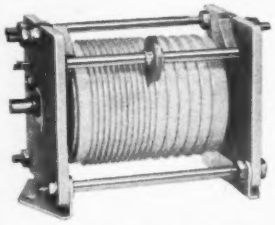
Variable inductor for high power applications. Winding is ½" copper tubing rated to 50 amperes current. Inductance continuously variable to 16.5 microhenries. Spring loaded silver plated roller contact permits adjustment with full power applied. Insulators are glass bonded mica; cast aluminum end frames are slotted to minimize Eddy current losses. Overall dimensions: length 21⅛", width 9", height 9". Available in eight standard models, maximum inductances 10 thru 110 microhenries. Variations from standard units such as special inductances, dual inductors for push-pull applications can be readily furnished in production quantities.



229-201

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In addition to these illustrated types, the JOHNSON line includes many other variable and fixed inductors for low, medium and high power applications. Fixed inductors are available with single or multiple windings, fixed or variable coupling windings and with electrostatic shields.

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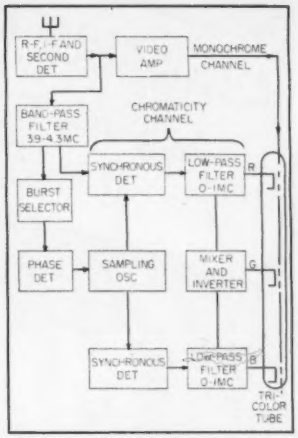


FIG. 1—Block diagram of color-tv receiver

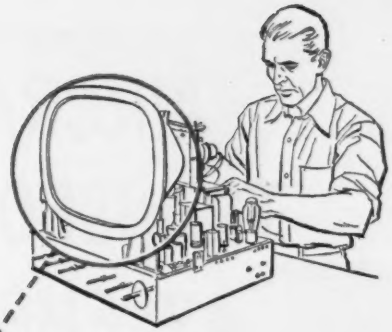
maticity channel,[3] see Fig. 1.

To recover the color information from the subcarrier, it becomes necessary to employ a process of synchronous demodulation or detection. The subcarrier contains two different sets of data provided by modulating the carrier both in amplitude and phase. The amplitude determines the color saturation and the phase modulation conveys the hue.

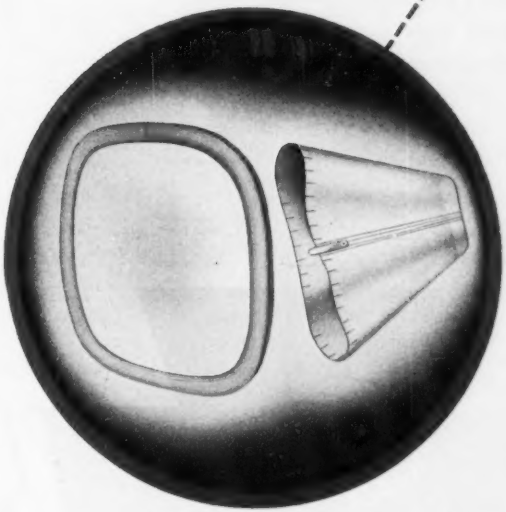
A more informative representation is to consider the subcarrier as composed of two sine waves in quadrature, each amplitude modulated. The problem is to recover the modulation information from each sine wave separately without crosstalk from the other.

Consider the circuit in Fig. 2, with the two sine-wave voltages applied to the control grid G_1 in quadrature as shown. The wave to be detected or demodulated is *ACE*. The sine wave which must contribute nothing is *BDF*. When switch S_1 is closed to the negative position, negative voltage on the screen grid G_2 of the tube, there can be no plate current. When the switch is thrown to the alternate position so that there is normal screen grid voltage, the tube functions in a normal manner.

Consider that there is negative voltage on the screen grid of the tube at all times except for an instant at time *B*. For each cycle of wave *ACE*, the tube functions in a



Du Pont "Alathon"* insulates TV tube carrying 20,000 volts



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Du Pont "Alathon" is widely used for such insulating applications as TV lead-in wire, high-voltage TV lead wire, and police and fire-alarm cable. We will gladly suggest suppliers who can meet your specific needs for electrical or other uses of "Alathon." For further information, write:

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This sounds trite but it's true . . . the Keystone imprint on a transformer is as good as the word "Sterling" on silver! The unit in the background consists of a power transformer and an input transformer. Also inter-stage transformer and output transformer. We build them open or hermetically sealed. Dependable deliveries by Keystone prevent production tie-ups. Get our estimate *now*. Prints and specifications should be sent to us via *registered* mail for safety.

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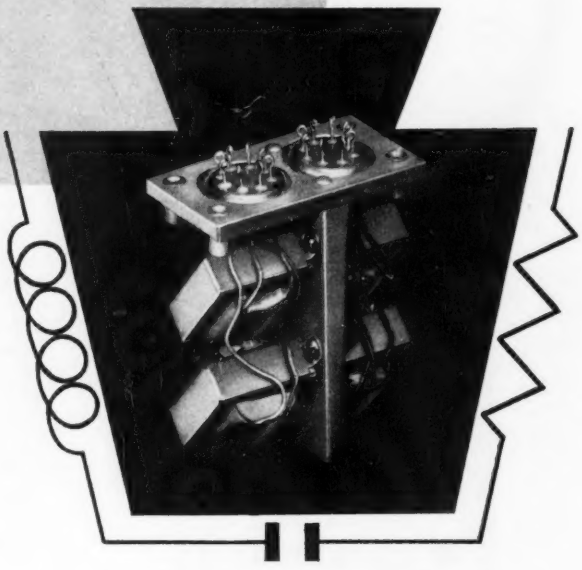

RIGHT—Open view of a Keystone Aircraft Transformer Assembly to show workmanship. This unit is being delivered hermetically sealed in ever increasing quantities each month.

KEYSTONE PRODUCTS COMPANY

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IDEAS *in the making*

Araldite Bonding and Casting Resins developed by Ciba Research are simplifying manufacturing methods, improving product efficiency, and opening new fields of product development. You will want to know more about them.*

ARALDITE® BONDING RESINS

ARALDITE® TYPE	CURING CONDITIONS	PHYSICAL APPEARANCE	BOND STRENGTH* ALUMINUM-ALUMINUM (LB./SQ. IN.)	SUGGESTED USE
AN-101	Room temperature	High viscosity liquid	2000-2500	Bonds or seals glass-metal.
AN-102	Room temperature	Low viscosity liquid contains solvents	1400-1600	Bonds metal-metal and metal-wood.
AN-111	Heat cure	Low viscosity liquid contains solvents	2000-2500	Impregnating (vacuum method), laminating and bonding.
AN-115	Heat cure	Low viscosity liquid contains solvents	2500-3000	Impregnating, laminating and bonding.
AN-106	Heat cure	Heavy paste silver color	3000-3200	Bonds socket-type joint.
AN-107	Heat cure	Heavy paste tan color	3000-3200	Bonds socket-type joint.
AN-112	Heat cure	Heavy paste tan color	2500-3000	Laminating, bonding. Rapid cure.
AN-100	Heat cure	Powder tan color	4000-4500	Bonds: Heat-resistant, smooth, non-porous materials . . . metal-metal, metal-glass, metal-ceramic, glass-glass
AN-110	Heat cure	Powder silver color	4000-4500	
AN-120	Heat cure	Stick tan color	4000-4500	
AN-130	Heat cure	Stick silver color	4000-4500	
AN-104	Room temperature	Non-flowing paste tan color	1000-1500	Bonds loose-fitting joints.
AN-103	Heat cure	Non-flowing paste tan color	1200-1400	Bonds loose-fitting joints.

*ASTM D1002-49T

ARALDITE® CASTING RESINS

ARALDITE® TYPE	CURE	PHYSICAL APPEARANCE	SUGGESTED USE	SHRINKAGE	ELECTRICAL PROPERTIES
CN-501	Heat cure	Amber solid	Casting, potting, encapsulating. Good adhesion.	Very low (½ to 2%)	Excellent
CN-502	Room temperature or heat cure	Thin liquid	Casting, potting, encapsulating. Good adhesion.	Very low (½ to 2%)	Good
CN-503	Room temperature or heat cure	Liquid	Similar to Araldite CN-501. Low temperature. Pour.	Very low (½ to 2%)	Excellent
CN-504	Heat cure	Very thin liquid	Impregnating, casting, potting, encapsulating. Good adhesion.	Low (< 2%)	Good

SEND THIS COUPON . . . or write us on your company letterhead . . . for complete technical data on the physical properties and recommended procedures for the successful use of Araldite Resins for your own fabricating needs.

*Reg. U.S. Pat. Off.

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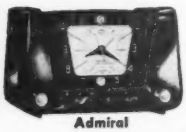
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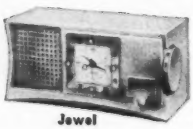
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normal manner at point B which corresponds to the time of maximum amplitude of this sine wave. If the amplitude of this sine wave varies, as with amplitude modulation, the pulses of plate current will vary in a like manner as shown. If the low-frequency component of these pulses is extracted as with a low-pass filter, the envelope of the wave will be reproduced as shown by the dotted line.

When examining the effect of sine wave BDF on this synchronous detector, remember that the plate current in the tube flows only at point B of each cycle, but sine wave BDF is zero at point B. Even though the amplitude of this wave increases or decreases, it will always be zero at the time of the sampling pulse. Therefore, the information contained in the modulation of wave ACE is recovered without crosstalk from the other sine wave BDF.

If the modulated subcarrier is fed to another synchronous detector which is pulsed on at time C, the information contained in wave BDF will be recovered. This type of synchronous detection was one of the first types used. Later methods of recovering the information use a synchronous sine wave in precisely the same manner as the synchronous pulse sampling.

Figure 3 shows a synchronous detector with desirable characteristics. The input signal is applied to the control grid G_1 while the sampling oscillator is applied to the suppressor grid G_3. Since the plate current of the tube is cut off when the suppressor is more negative

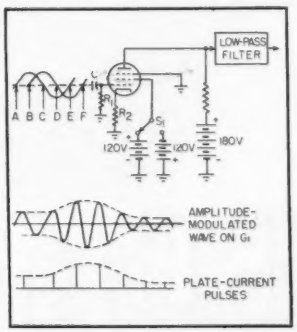
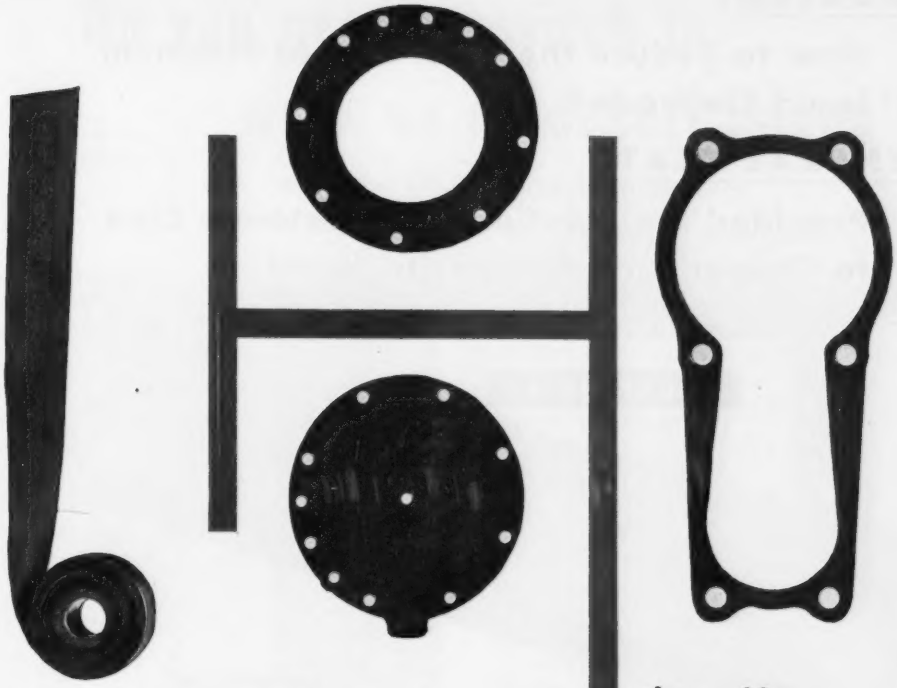


FIG. 2—Synchronous detector used in early work



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Silicone Rubber Coated Glass Cloth is ideally suited for seals, diaphragms and gaskets. One of its unique properties is the fact that it does not stick to metal parts when used for gaskets. It requires no scraping or peeling during disassembly.

In addition, this Class H insulation possesses good dielectric strength and low power factor. It can be used over a wide frequency range in many electrical applications.

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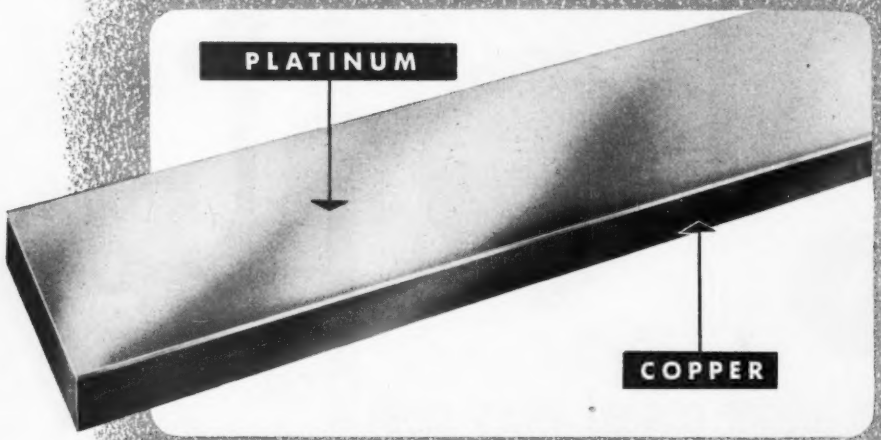

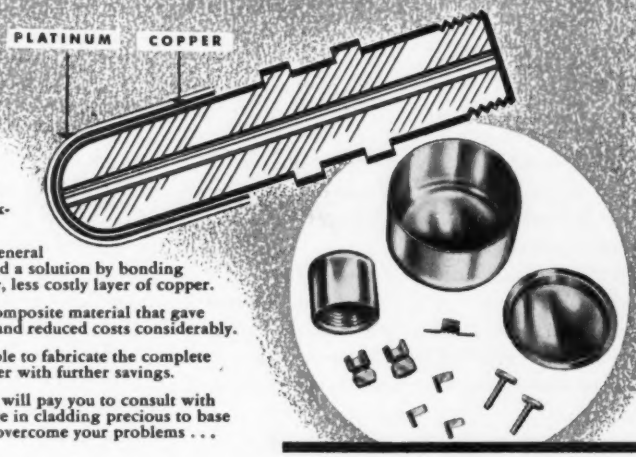

A well-known manufacturer was faced with the problem of how to cut the cost of a platinum electrode. Pure platinum was ideal but was expensive and the supply short.

The problem was presented to General Plate whose engineers quickly found a solution by bonding a thin layer of platinum to a thicker, less costly layer of copper.

The result was a General Plate composite material that gave the performance of pure platinum, and reduced costs considerably.

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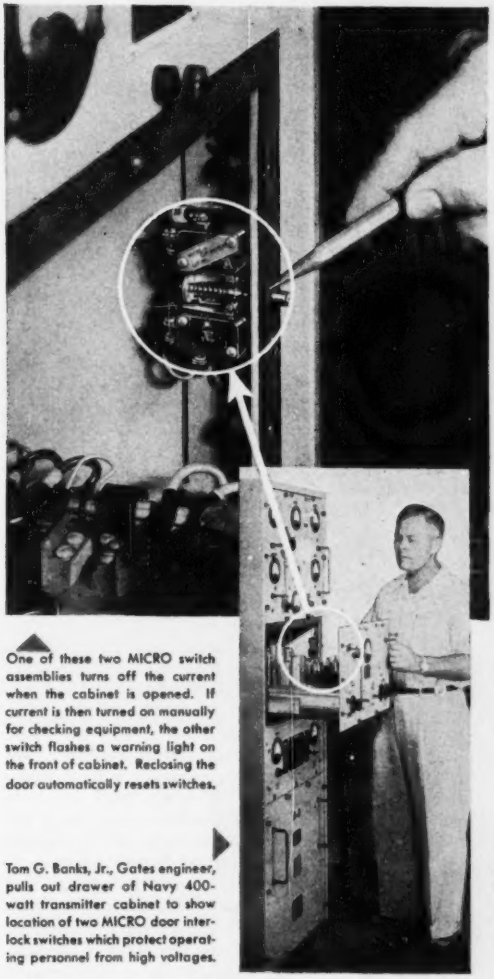
SWITCHES IN GATES RADIO'S NAVY BROADCAST TRANSMITTER



One of these two MICRO switch assemblies turns off the current when the cabinet is opened. If current is then turned on manually for checking equipment, the other switch flashes a warning light on the front of cabinet. Reclosing the door automatically resets switches.

Tom G. Banks, Jr., Gates engineer, pulls out drawer of Navy 400-watt transmitter cabinet to show location of two MICRO door interlock switches which protect operating personnel from high voltages.

Radio transmission in the Navy recognizes no climate. Equipment must be ready to "send" instantly after a splash through the surf to a humid, south sea "desert island" or a trek over the ice to an Aleutian hut.

These high voltage transmitters must be safe, too. There must be no danger to personnel from the 2500 volts if the door is opened accidentally.

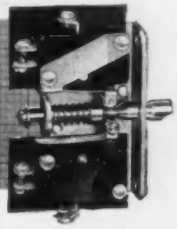
These were just a few of the exacting requirements which faced engineers of the Gates Radio Company when they designed their AN/URN-5 Radio Beam Transmitter for the U. S. Navy. For a door interlock switch that would always work, under all conditions, they turned to MICRO. This switch, they told us—

1. Must be made of materials which would be unaffected by fungus or corrosion.
2. Must operate perfectly in temperatures ranging from −55° to +65° C.
3. Must withstand high humidities up to 95%.
4. Must withstand Class B military shock and vibration tests.
5. Must meet rigid "JAN" specifications.

These requirements were met in every particular by the MICRO double door interlock switch; now three of these units guard each door of this Navy transmitter.

This recognition on the part of Gates engineers of MICRO precision and dependability as components of equipment which must not fail is typical of confidence industrial designers everywhere place in MICRO engineering. MICRO has, or can develop, a switch to meet YOUR most exacting problem. Field engineers are located near you to cooperate in the solution of YOUR switch problem. We invite you to call the nearest MICRO branch.

Let a MICRO Engineer show you how you can "Use MICRO Precision Switches as a principle of good design"



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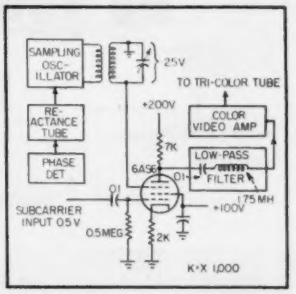

FIG. 3—Synchronous demodulator with desirable characteristics

than −10 v, every negative peak is limited.

If the input signal to G_1 is in phase with the sampling oscillator voltage on G_2, G_1 will go positive when G_2 goes positive. The transconductance of the tube increases greatly and there is heavy plate current on the positive peaks. These plate-current pulses will follow the modulation which is impressed on the wave on G_1. The response of the tube is linear to the G_1 voltage.

The detector will again ignore the quadrature component of the frequency on G_1 although this component will again produce phase shift of the plate-current pulses. This component can be recovered by applying the same signal to another synchronous detector on whose suppressor there is a frequency which is in phase with the desired signal on G_1.

If the frequency on the suppressor is not the same as the frequency of the modulated wave on the control grid, there will be a beat frequency and the usual superheterodyne mixer circuit emerges. The difference frequency will be modulated in accordance with the combined amplitudes on G_1. There will be other products of the mixing process just as in any mixer.

The difference frequency may readily pass through the low-pass filter. This suggests a method of adjusting the frequency of the sampling oscillator in a synchronous demodulator circuit. With an oscilloscope on the output of the low-pass filter and a pure unmodulated sine wave on G_1 and G_2, the frequency of one is varied. The scope will show the beat frequency. As the frequency on G_1 approaches G_2,

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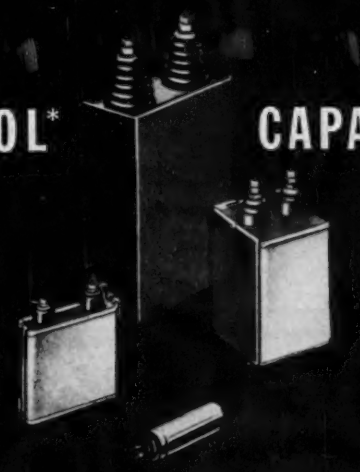

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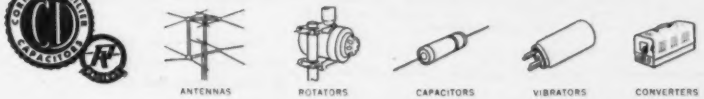

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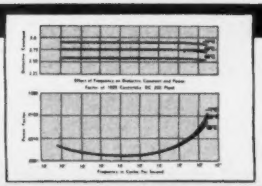
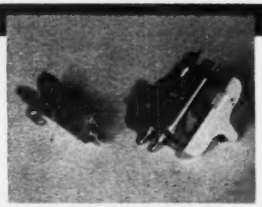


As indicated by these curves, neither frequency nor temperature changes have any pronounced effect on the power factors or dielectric constants of Dow Corning 200 Fluids. Power factor and dielectric constant of 1000 cs. fluid at −17°, 23°, and 83° C. are plotted against frequencies ranging from 10 to 10^{10} cycles per second.

DIELECTRIC COMPOUND

DOW CORNING 4 COMPOUND is a nonmelting water-repellent dielectric paste which retains its grease-like consistency at temperatures from −70° to 400°F. It is highly resistant to oxidation and to deterioration caused by corona discharge. Power factor is less than 0.003 at frequencies up to 10,000 megacycles; volume resistivity is more than 10^{Ω} ohm centimeters at temperatures up to 400°F.; dielectric strength is more than 500 volts per mil at a 10 mil gap. Dow Corning 4 meets all requirements of Specification AN-C-128a.



Dow Corning 4 packed in phonograph pick-up head cartridges increased crystal service life 20 times. The silicone compound prevents Rochelle Crystals from deteriorating due to absorbed moisture. It also acts as a viscous damping medium, thereby reducing excess vibration and enabling the head to handle a much higher frequency.

ELECTRICAL INSULATING VARNISHES

DOW CORNING 996 VARNISH dries tack-free in not more than 3 hours at 150°C. Dielectric strength measured with 2 inch electrodes on 2 mil films baked for 16 hours at 150°C. is 1000-2000 volts/mil, dry, and 500-1500 volts/mil, wet. Heat flexibility is more than 100 hours at 250°C. Cured films have good resistance to dilute acids, concentrated hydrochloric acid, and dilute or concentrated alkalies.

Flashover in high voltage television power supply coils can set ordinary organic varnish aflame. To eliminate this fire hazard, coils are impregnated with Dow Corning 996. Highly resistant to arcing, 996 provides positive protection against carbon tracking for the life of the entire set.

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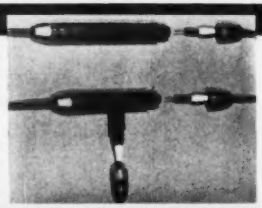
Silastic combines the remarkable heat stability and moisture resistance of resinous silicones with the physical properties of rubber, including resilience, shock and abrasion resistance, and resistance to both mechanical and electrical fatigue. Its dielectric properties show little change over a wide range of frequencies, even after aging at high temperatures. The surface resistivity of Silastic is high, and its thermal conductivity is about twice as great as that of either organic rubber or resinous insulating materials.

*T. M. REG. U.S. PAT. OFF.



Completely eliminating taped connections on aircraft antennae, white Silastic seals reduce static and corona discharge by as much as 90%. They retain their resilience as well as their dielectric properties, excluding moisture and foreign matter after long exposure to the full range of ground and stratospheric temperatures.

SILICONE-GLASS LAMINATES

DOW CORNING THERMOSETTING RESINS are used to bond inorganic fabrics and finely divided particles such as powdered metals or mica. Typical ⅛" silicone-glass laminates have a flexural strength of 22,000 to 45,000 psi; water absorption after 24 hours of 0.25 %; dielectric strength with continuous filament cloth of 250 volts/mil or more; power factor of 0.002 at 1 mc; loss factor of 0.007 at 1 mc; wet insulation resistance of more than 10^{12} ohms; arc resistance of 300 seconds and a heat distortion value above 250°C.

For maximum dependability and long service life, silicone-glass terminal blocks and contactor bases are being used in late model automatic toasters. Tests prove that Dow Corning silicone resin bonded glass laminates are more rigid, more heat-stable, more resistant to moisture and easier to fabricate and assemble than conventional materials.

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DIGITAL RECORDER . . . Series 1550 is composed of a Readout unit and a Printing Recorder. The first unit consists of a bank of readout decimal counting units essentially paralleling the totalizing function of the basic counting instrument from which they operate, and a selecting relay matrix to channel information from the counting circuit to the Printing Recorder. This second unit presents a sequence of total counts in direct reading digital form on a standard adding machine tape.

A COMPLETE SYSTEM . . . of Electronic Counter and Digital Recorder then consists of three elements: a suitable electronic counting device, Readout unit, and Printing Recorder. The latter two elements comprise the complete Digital Recorder. Under certain conditions a special modification of the system will permit original count information to be channeled directly into the Readout unit, thus eliminating the need for a separate electronic counter.

SPECIFICATIONS . . . Minimum counting period determined by the characteristics of the basic counting instrument. Maximum cycling rate: 1 printout every ¾ second. Indicating capacities 3, 4, 5 or 6 columns. Readout Unit—20¾" x 10½" x 15" cabinet, wt. 60 lbs., standard 19" relay rack panel. Printing Recorder—7½" x 8¼" x 14½" cabinet, wt. 20 lbs. Price, Digital Recorder, Model 1553 (3-column), $1050; Model 1554 (4-column), $1125; Model 1555 (5-column), $1200; Model 1556 (6-column), $1275, f.o.b. factory.

M-2

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the number of cycles on the scope will become fewer and fewer until the two frequencies are the same. If the sampling oscillator has the proper lock-in circuit, the frequencies will then lock in synchronism. The scope display is then a straight line. Assuming G_1 and G_2 are in phase, if modulation is applied to the wave on G_1, the modulating wave will appear on the scope.

This type of synchronous detector functions similiarly to the mathematical process of trigonometric multiplication. After the electrons in the detector tube leave the cathode and receive modulation at G_1, they pass to the neighborhood controlled by G_2 and are again acted upon. Another viewpoint is to consider that the instantaneous voltage on G_1 determines the amount of current and the instantaneous voltage on G_2 determines the proportion of that current that goes to the plate of the tube. The first function G_1 is multiplied by the second G_2.

REFERENCES

(1) D. G. Fink, Plans For Compatible Color Television, ELECTRONICS, 24, p 90, Aug. 1951.

(2) C. J. Hirsch, W. F. Bailey and B. D. Laughlin, Principles of NTSC Compatible Color Television, ELECTRONICS, p 88, Feb. 1952.

Counter Test Circuits

BY RICHARD WEISSMAN

Senior Engineer
Cook Research Laboratories
Skokie, Illinois

TO STUDY the behavior of a ternary counter, it was found helpful to use certain auxiliary equipment. A monopulse generator proves convenient in locating faults in any complex counting operation. To obtain a single keyed pulse directly from a switch closure is extremely difficult when an identical waveform, free from raggedness and spurious transients, is desired.

Another small unit which has proved invaluable in the study of waveform transitions is the variable delayed trigger circuit for initiating the oscilloscope sweep. When it is desired to view a small detail of a recurrent waveform on a greatly expanded time scale, it is usually impossible to select the particular detail for display from the entire pattern with the regular oscilloscope controls without at least

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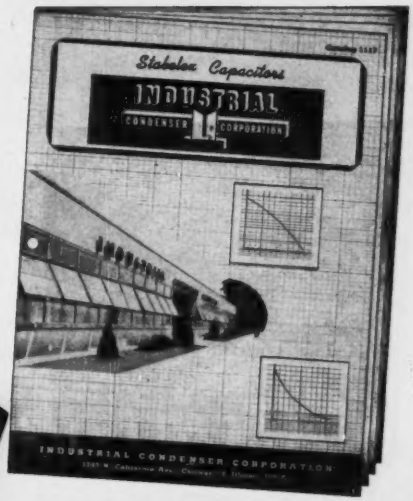

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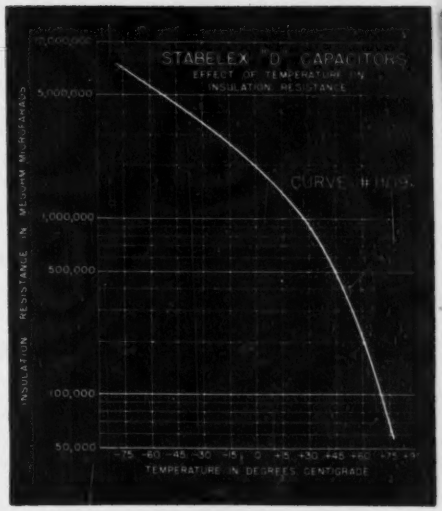

The unusually high insulation resistance at 20° C. in turn insures unusually high resistance at temperatures up to 75° C. The insulation resistance of these capacitors at 75° C. is approximately ten times that of commercial oil capacitors at 20° C. This is well illustrated in Curve #1109.

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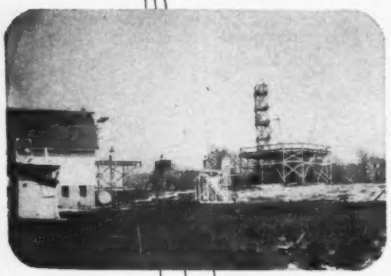
antenna research, development facilities

The 420-acre ANDREW research Center, including a mile-long testing range, is devoted entirely to antenna research and development. In addition to the many Andrew standard models which have been developed here, several research and design problems have been undertaken on both prime and sub-contracts. The use of these facilities can be of material assistance in the design and manufacture of systems, associated equipment or in the development of custom antenna equipment.

The testing range utilizes this platform and various towers for antenna field testing. Recently, a full-scale model of the Empire State Building's conical upper section was built on the platform for testing television transmitting antennas. The ANDREW "Skew" antenna developed from the tests is now in use on the Empire State Building.



At this large, well equipped Center, a wide range of equipment and set-ups are available, both indoors and out. Antenna problems are solved by antenna specialists—equipment and experience cover 50 KCS to 20,000 MCS—these enable ANDREW to accept a wide range of antenna development and engineering responsibilities.

The large indoor laboratory has provisions for handling large equipment and is equipped with complete machine shop and metal working facilities. Testing is done in the upper portion of the building where the all-wood construction and elimination of metallic surfaces permit undistorted operation of the test set-up.

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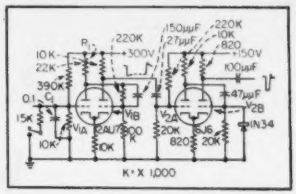

FIG. 1—Schematic diagram of the monopulse generator

destroying the sweep-speed calibration.

By initiating the sweep from an external variably delayed trigger it is easy to magnify any desired part of a waveform, such as a fast transition in a slowly recurring pattern, using any sweep speed up to the maximum capabilities of the scope without changing the calibration or linearity of the sweep.

Figure 1 shows the circuit for the monopulse generator. Triode V_{1A} is normally conducting but when the key is depressed, the grid voltage drops exponentially until the multivibrator action flips the V_{1B} plate into conduction. The differentiated negative step triggers V_2 which is a monostable trigger circuit delivering a single one-microsecond negative pulse each time it is triggered.

Resistor R_1 prevents free running in the V_1 multivibrator so that the key must be released before the circuit can flip back to normal. Relaxation time, controlled by C_1, is sufficient to prevent double pulsing from switching transients.

The variable sweep delay is shown in Fig. 2. A cathode-coupled monostable multivibrator is triggered by the signal at some fixed time in each cycle. When the circuit flips back to the stable condition, a positive output pulse is derived by the C_1R_1 differentiating circuit. The crystal diode prevents the initial negative multivibrator pulse from appearing at the output. The time required for the right-hand grid to relax and flip the circuit back is determined by the setting of the switch and the fine-delay potentiometer.

The sweep, triggered by the multivibrator output pulse is delayed until the occurrence of the desired portion of the signal. The multivibrator may be triggered conveniently from one of the vertical de-

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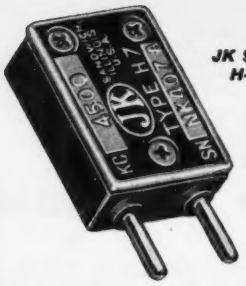

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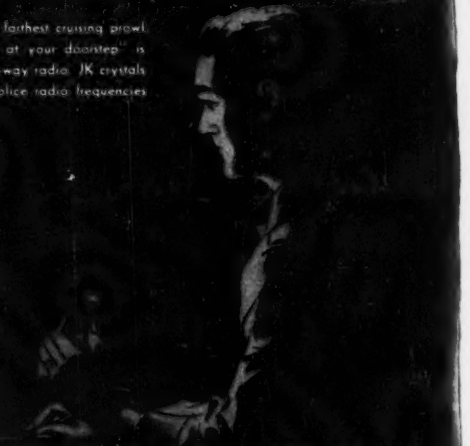

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Announcing Radio Receptor's new range of

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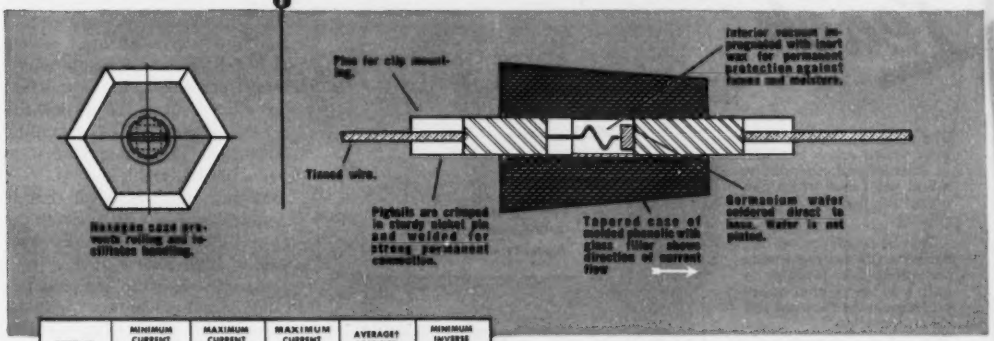
ACTUAL SIZE

Keynoting sound design features and simplicity in construction, the new Radio Receptor Germanium Diodes will give a maximum of trouble-free operation even under the most adverse conditions.

Normally in diodes such as these, one side of the germanium wafer is plated so that it may be soldered to the base . . . but Radio Receptor's improved production methods make it possible to *omit* plating, thus eliminating possible flaking and improving quality.


Pins for clip mounting.
Interior vacuum impregnated with inert wax for permanent protection against fumes and moisture.
Tinned wire.
Hexagon case prevents rolling and facilitates handling.
Pigtails are crimped in sturdy nickel pin and welded for strong permanent connection.
Tapered case of molded phenolic with glass filler shows direction of current flow
Germanium wafer soldered direct to base. Wafer is not plated.

CODE NO.	MINIMUM CURRENT AT 1 VOLT FORWARD MA	MAXIMUM CURRENT AT 10 VOLTS REVERSE MA	MAXIMUM CURRENT AT 50 VOLTS REVERSE MA	AVERAGE† RECTIFIED CURRENT MA	MINIMUM INVERSE PEAK VOLTS
1N48	4.0	—	0.833	50	85
1N51	2.5	—	1.667	25	50
1N52	4.0	—	0.150	50	85
1N63	4.0	—	0.050	50	125
1N64	Minimum of 0.100 MA in 44 MC Test Circuit				20
1N65	2.5	—	0.200	50	85
*1N69	5.0	0.050	0.850	40	75
*1N70	3.0	0.025	0.300	30	125
1N75	2.0	—	0.050	50	125
*1N81	3.0	0.010	—	30	50

*JAN type

†Average half wave rectified current at 60 CPS and 25° C. Consult us for ratings at other conditions.

The distinctive tapered shape of the glass-filled phenolic cartridge body indicates the direction of current flow, while the hexagon form assures ease of handling — Prevents rolling, especially when the leads are cut off to permit mounting the diode in clips.

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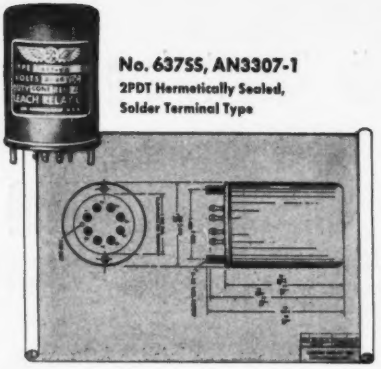
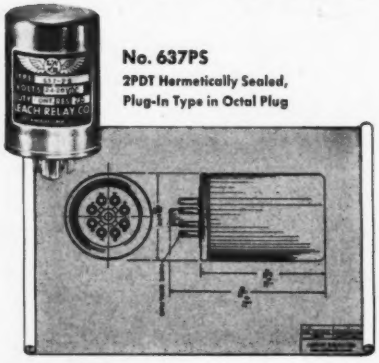


No. 637SS, AN3307-1
2PDT Hermetically Sealed, Solder Terminal Type



No. 637PS
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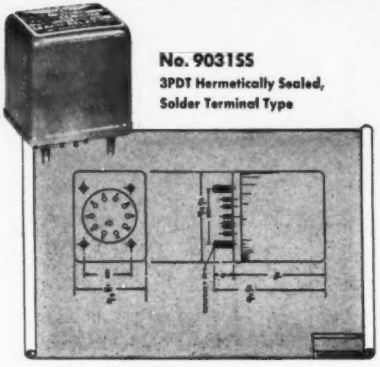

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Performance characteristics for the Relays illustrated above are as follows:

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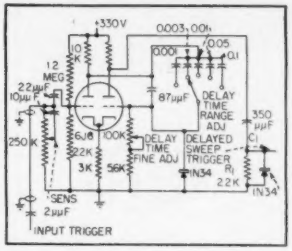

FIG. 2—Variable sweep delay circuit

flection plates of the oscilloscope through a 2-μμf capacitor to avoid loading either the scope or the circuit under test.

Remote-Controlled Broadcast Transmitter

BY V. E. HUGHES
Marconi's Wireless Telegraph Company Chelmsford, England

UNATTENDED remotely-controlled radio transmitters offer numerous advantages, outstanding among which are the major points of releasing personnel for important work other than at the station site and the feasibility of installing transmitters in remote places, to cover a limited area.

One pair of lines is all that is necessary to remotely control the station. Programs are sent over a pair of high-quality lines.

Compactness of the equipment is an additional advantage and the self-contained monitoring circuits automatically close down a faulty section of the installation while good sections carry on the program.

Installations of ½ to 2 kw can be made up of the units which comprise the robot transmitters shown in the photograph. Units are of 500 to 660 watts output, each unit being a complete transmitter. The units are operated singly, at reduced power, or in parallel. Each has monitor circuits which check phase difference between r-f drive input and r-f output, amplitude of the r-f drive and output, as well as the a-f input and output.

Each transmitter is enclosed in an aluminum alloy cabinet, and access is required only at the front, thus allowing the units to be placed close to a wall.

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Centrifugal Blowers for their new Super Constellations

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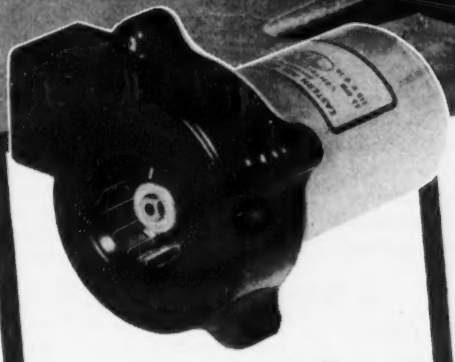
Right in the heart of this giant's main electrical system TWA specified EAD's J 55-C Centrifugal Blowers, to cool the vital voltage regulators. These amazing midgets weighing only approximately 18 ounces met every rigid specification. Another outstanding example of EAD's ability to produce the finest in rotating electrical equipment.

"Choose EAD for reliability"



J 55-C CENTRIFUGAL BLOWER

Overall Dimensions
(3-11/16"x2-29/32"x2-15/16")

SPECIFICATIONS:

- 115 Volts
- 400 Cycles
- 7000 RPM
- Single Phase
- 1 Amperes
- 1.12 lbs. wgt.
- 13 CFM 0" Static Pressure

Meets all military specifications for corrosion resistance, fungus-proof, humidity, shock and vibration.

APPLICATIONS

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And yet today our patent attorneys can be numbered on the fingers of two hands!

The explanation is, of course, that our growth has been very rapid and we have gotten a late start in trying to build an appropriately large patent department. The situation has not been made any easier for us by a current rapid expansion of our commercial, nonmilitary interests. As a result, however, we believe that the opportunities for patent attorneys are now unusually attractive at Hughes.

To keep abreast with the work being done in our Laboratories, our patent department must be greatly enlarged; this means that today's openings carry unusual potentialities for rapid advancement. On the other hand, the fact that the Research and Development organization to be served has already established itself as one of the largest and most productive electronics laboratories in the country provides a degree of security not usually associated with opportunities for rapid individual growth.

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Culver City, Los Angeles County, California

Assurance is required that re-location of the applicant will not cause disruption of an urgent military project.

in the base of the cabinets and, to facilitate removal and replacement, the location of heavy components is by spigots.

Individual chassis do not exceed 50 lbs in weight.

The drives supplied with these transmitters fulfill the requirements of the Copenhagen Plan and have a day-to-day stability of one in one million.

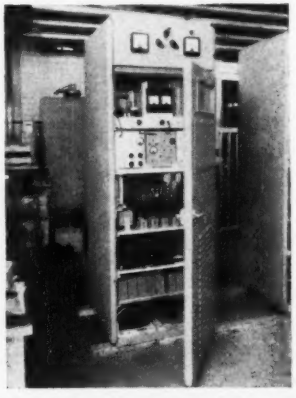
Two drives are supplied. These are mounted in a separate cabinet, which is smaller than the transmitter cabinet. This cabinet houses also the transmitter control circuits.

Should high precisions drives be required for common wave or synchronous working, these can also be supplied and used without alterations to the transmitter. Such drives have a day-to-day stability of one in 100,000,000.

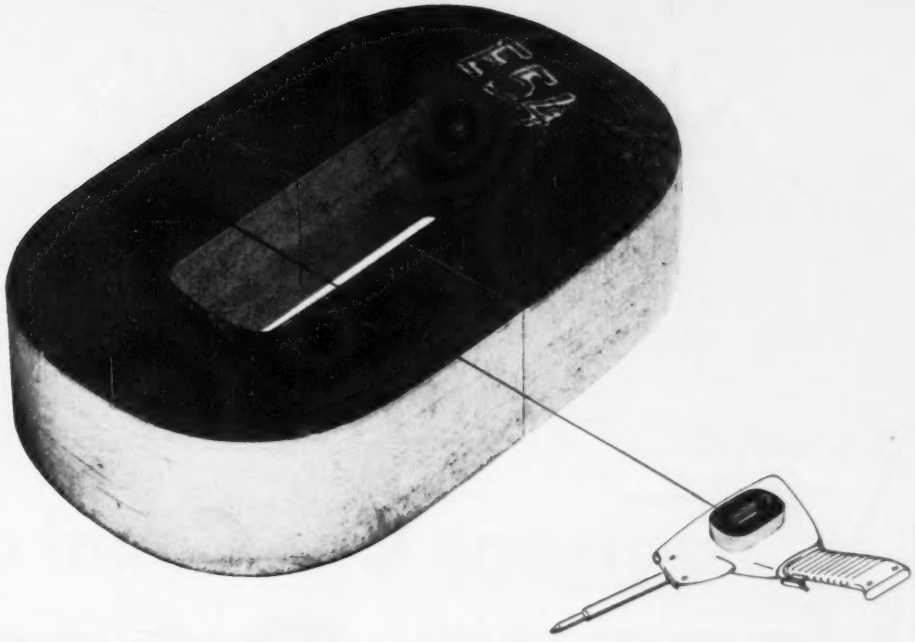
The r-f amplifier consists of two beam tetrodes in parallel and the anode circuit of this stage is tuned by an L-C circuit. The output is then R-C coupled to the grids of the modulated amplifiers.

The anode circuit of the penultimate stage of the transmitters is used for effecting phase adjustment. In this stage the anode voltage is provided by a 500-v auxiliary rectifier.

The modulated amplifier, consisting of two transmitting triodes



One of the 660-watt unattended transmitters. Top shelf, modulator and modulated amplifier; second shelf (left to right) submodulator, monitor unit, r-f amplifier; third shelf (top) contactor panel, (bottom) bias rectifier chassis. The lower three shelves contain the high-voltage rectifiers and auxiliary rectifiers



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In designing their new Versa-Tool soldering gun, Phillips Manufacturing Company wanted a power unit that would provide instantaneous heat for off-on operation, yet operate on household voltage. A transformer was needed to build adequate amperage. But it had to be small, to fit into the handle . . . lightweight, for balance . . . reasonable in cost, to insure competitive pricing of the assembled unit.

Westinghouse Type RC Hipersil Cores provided the complete answer.

Because Hipersil Cores have greater flux-carrying capacity, Phillips engineers were able to cut size and weight of the transformer, effecting considerable savings in coil as well as core costs. But, better still, because the two-piece cores simplified assembly, manufacturing costs were slashed.

Hipersil Cores can cut cost, size and weight in all types of electrical and electronic transformers. Available in a wide range of sizes and shapes for low or high-frequency applications. Greater flux-carrying capacity, compact construction, plus the savings they effect in your manufacturing costs make them the best transformer cores on the market today. For more technical information on applying Hipersil Cores to your product, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70628

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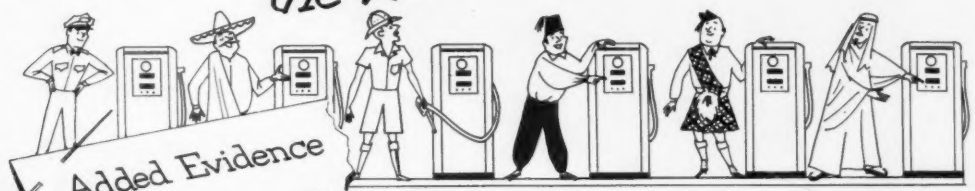
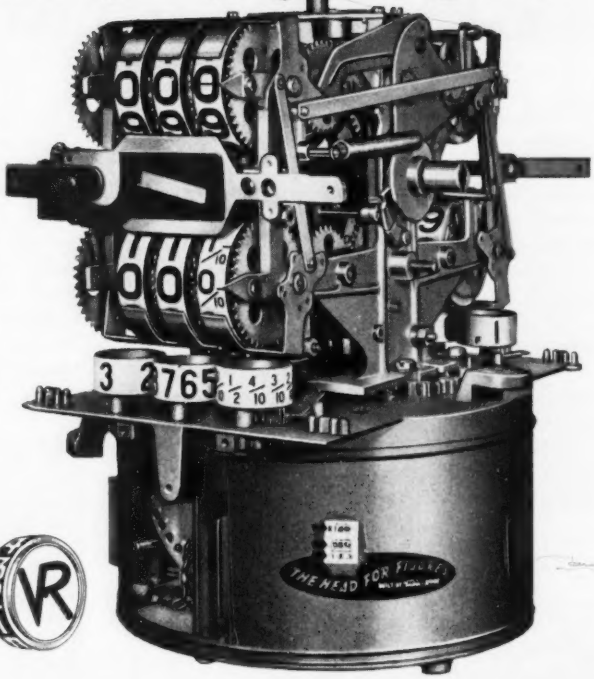
It Computes the Cost of Gasoline Pumped... in All of the World's Currencies



Added Evidence that—

Everyone Can Count on

VEEDER-ROOT



Yes, this Veeder-Root Gasoline Pump Computer speaks the languages of 144 countries! A rugged, accurate mechanism of 800-plus parts, it's the modern protection given you by gasoline pump manufacturers, gasoline refiners and their service-station outlets . . . *to make sure you get full measure in your tank, and the right change in your pocket* (or you can buy in "even money"). And what's more, it underscores the fact that "Veeder-Root Counts Everything on Earth" . . . electrically, mechanically or manually . . . with standard and special devices of every conceivable type. Do *you* have a counting problem, in any of your defense work or any of your regular production? If so, you can count on V-R to help you in every possible way.

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- Greatly simplifies all in-flight navigation computations.

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We have prepared a descriptive booklet on the Collins Navigation Computer and will be glad to mail you a copy on request. Also available are 16-mm demonstration films of the Collins Flight System.

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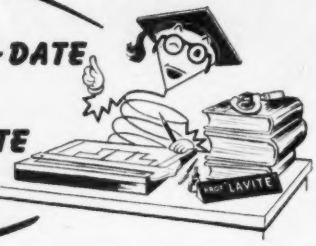

Let me first emphasize the essential difference between *"Lavite"* Ferrites and general Ferrites. When you use "Lavite" Ferrites, you first have all of the desirable basic advantages of this type of material. These advantages are many varieties in composition to better meet specific electrical properties that may be required as to high saturation, higher permeabilities, high Q and FM frequencies, low temperature coefficient, etc.

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3. Interestingly low production costs of these parts, and
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And in addition to all this, you are invited to consult Steward engineers, without obligation, for scientific answers to your specific problems. Send me your specifications.

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operated at an anode voltage of 1,600 v, is modulated by two tubes of the same type operated as Class-B modulators.

A-F Stages

The line input is transformer-coupled to the low-frequency amplifier which is a preamplifier employing high slope pentodes in push-pull. Output from the preamplifier feeds two tetrodes which act as a push-pull amplifier driving the cathode followers. The a-f amplifiers and cathode-follower stages are all fed from the auxiliary rectifier.

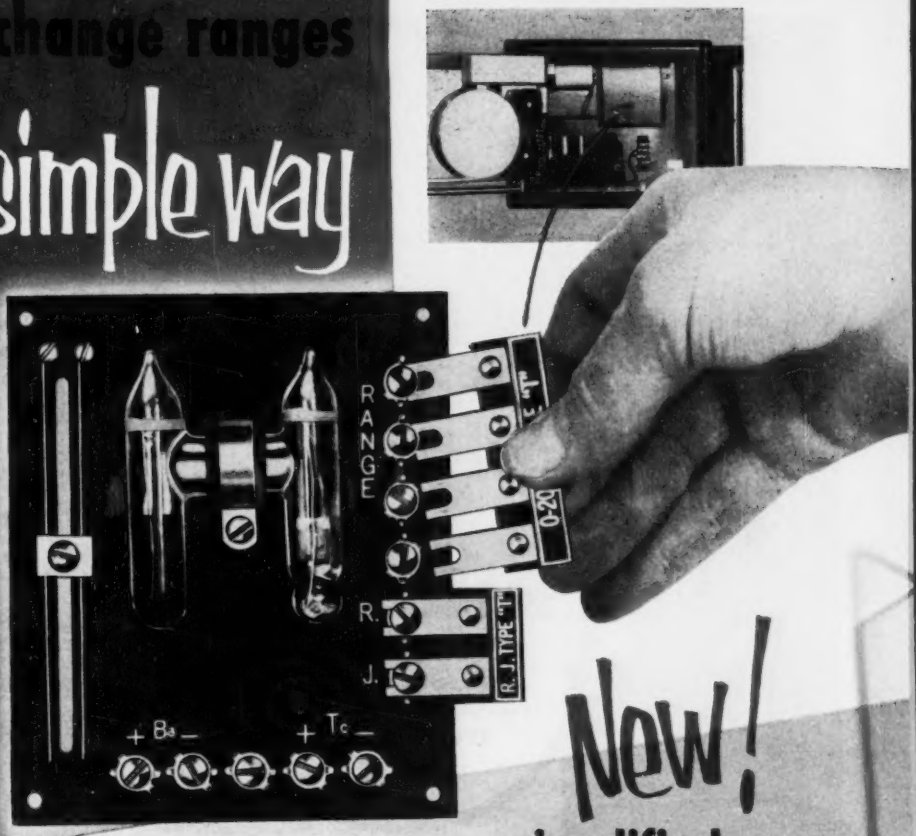
When two or three transmitters are used to give higher power, three transmitters for 2 kw, they are mounted side by side. The output feeders of each transmitter unit are paralleled and connected to a transducer, the elements of which are switched by contactors. This allows the correct matching of one, two or all transmitters. The transducer consists of an inductance, capacitors and contactors, all of which are liberally rated and carefully designed thus eliminating the need for an automatically switched spare unit.

A change-over contactor is provided in the output feeder of each transmitter and is arranged to switch the transmitter output to either the transducer or a test load. Separate test loads are provided for each transmitter and this arrangement enables the transmitters to be tested independently. Facilities for automatic checking are also included.

As stated previously, each transmitter is provided with two monitoring circuits, one for the r-f chain and one for the modulator. The r-f amplitude and phase monitoring is achieved by comparing vectors derived by direct capacitive coupling from the antenna output and the r-f drive input to the transmitter. These vectors, when all is well, are applied in antiphase to the monitor and adjusted to give equal amplitude.

The resultant voltage is rectified and applied to the grid of a tube, in the anode circuit of which is a relay. The tube under normal conditions carries current and holds the relay energized. A fault con-

You change ranges this simple way



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Recording Potentiometer by WESTON

The question probably occurs to you, as it has to many other instrument users who have examined the new WESTON Recording Potentiometer, "Why haven't such improvements been offered before?"

Take range changing, just as an example. *You* make the change, simply by inserting the desired range standard, as illustrated above. Not even a soldered connection to break. No change in the universal slide-wire necessary. And reference junction compensation is changed in like manner, when changing type of sensing element.

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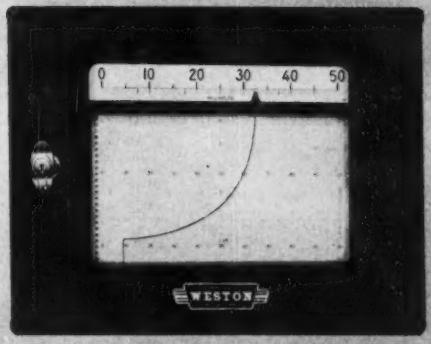

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FROM GROUND TO AIR OR POINT TO POINT

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High stability (.003%) under normal operating conditions.

RUGGED

Components conservatively rated. Completely tropicalized.

Model 446 transmitter operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.5-13.5 Mcs (1.6-2.5 Mcs available). Operates on one frequency at a time; channeling time 2 seconds. Carrier power 350 watts, A1 or A3 AM. Stability .003% using CR-7 (or HC-6U) crystals. Operates in ambient 0° to + 45° C using mercury rectifiers;-35° to + 45° C using gas filled rectifiers. Power supply, 200-250 volts, 50/60 cycles, single phase. Conservatively rated, sturdily constructed. Complete technical data on request.

Here's the ideal general-purpose high-frequency transmitter! Model 446... 4-channel, 6-frequency, medium power, high stability. Suitable for point-to-point or ground-to-air communication. Can be remotely located from operating position. Co-axial fitting to accept frequency shift signals.

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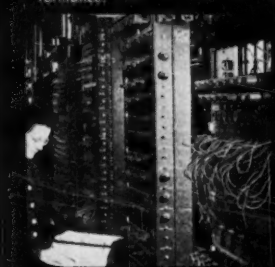

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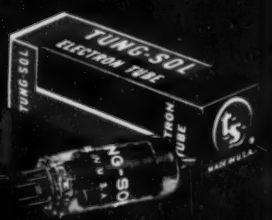

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Anodes for hydrogen thyratron electronic tubes. The disks are heavy molybdenum sheet. The shafts are made of tungsten rod.

If you are a user of tungsten and molybdenum, consult Fansteel (without obligation) for assistance in design and most economical fabrication.

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Fansteel Metallurgical Corporation NORTH CHICAGO, ILLINOIS, U.S.A.

dition backs the tube off and de-energizes the relay. A stage of amplification follows the drive to provide isolation and sufficient amplitude for the monitor.

To overcome the effect of modulation on the vector from the antenna output terminal, a rectified signal proportional to the incoming audio frequency is used as a variable bias on the relay tube.

The a-f monitor compares the input audio signal with the output, taken from the modulation transformer. The two signals are made equal under normal conditions and the difference is made to operate a relay when a fault condition occurs. The transmitters will then be checked by their monitors. The defective transmitter will be switched off but the good transmitters are returned to the output bus bar.

The time taken for the transmitters to switch to test load, check, and switch back to the output feeder is of the order of 5 to 10 seconds. A reasonable time delay on the operation of the monitors is in any case essential in order to avoid the transmitters switching out due to momentary over-modulation peaks.

These monitors obviate the need for overload protection on individual tubes because a fault on any tube in the transmitter will operate either of the monitors.

Low-Copper Sweep Yoke

By C. E. Torsch

Receiver Department
General Electric Company
Syracuse, New York

Unorthodox coil utilization provides improved sensitivity, balance and focus uniformity. An improved high-frequency coil design minimizes a common defect in yoke performance—sweep velocity modulation.

Novel manufacturing methods were developed to yield precise coil, insulator and coil form shapes to gain performance through compactness.

Conventional yoke connections use the slightly shorter pair of yoke coils for vertical sweep. The longer coils are used for horizontal sweep, favoring the more difficult task with the more sensitive, long coils. Shape interlock of the coil ends

Miniature Terminal Panels

The Fusite line of glass-to-steel hermetic terminals has kept pace with the trend toward miniature sizes. As interest in these small sizes continues to increase, we present herewith a complete line of both regular and plug-in types now available from Fusite. These terminals are available in several flange variations in addition to those shown. Write to Dept. (B) for engineering drawings and complete dimensions.

4-900 SERIES

1000 V (RMS)

Available in 2 to 9 turret head straight wire or looped electrodes.

4-909 THSW-2E illustrated

4-1100 SERIES

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Available in 2 to 11 turret head straight wire electrodes.

4-1109 THSW-2F illustrated

4-1400 SERIES

1000 V (RMS)

Available in 2 to 14 turret head straight wire electrodes. Also available with longer center electrodes as -1.

4-1414 THSW-2-2F illustrated

4.5-1400 SERIES

1250 V (RMS)

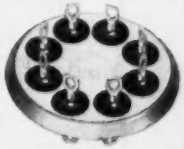
Available in 2 to 14 turret head straight wire electrodes. Also available with short center electrodes as —2.

4.5-1414 THSW-1-2H illustrated

5-900 SERIES

1500 V (RMS)

Available in 2 to 9 flattened and pierced or looped electrodes.



5-908 FP-1B illustrated

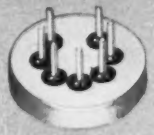
INSULATE ELECTRICALLY GLASS TO METAL FUSITE TERMINALS PROTECT PRODUCT PERFORMANCE GLASS TO METAL HERMETICALLY

FOR PLUG-IN APPLICATIONS

4-907 PISW

1000 V (RMS)

For top side plug-in to standard 7 pin miniature socket.



2E Flange illustrated

4-907 THPI

1000 V (RMS)

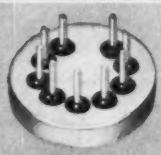
For bottom side plug-in to standard 7 pin miniature socket.

2E Flange illustrated

4-1109 PISW

1000 V (RMS)

For top side plug-in to standard 9 pin miniature socket.



2F Flange illustrated

4-1109 THPI

1000 V (RMS)

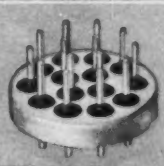
For bottom side plug-in to standard 9 pin miniature socket.

2F Flange illustrated

4-1414 PISW

1000 V (RMS)

For top side plug-in to standard 14 pin miniature socket.



2F Flange illustrated

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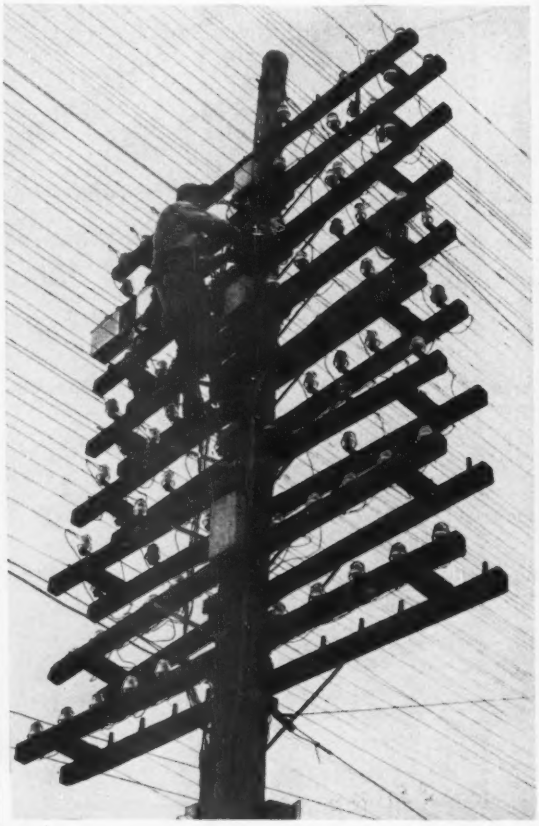
Same wires– many more voices

Connecting new multi-voice system to open-wire lines, near Albany, Georgia. With new system, 150,000 miles of short open-wire telephone lines can be made to carry up to 16 simultaneous messages economically.



MUCH of your Long Distance telephone system works through cable but open-wire lines are still the most economical in many places. Thousands of these circuits are so short that little would be saved by using elaborate carrier telephone systems which are better suited for long-haul routes. But a new carrier system . . . the Type O designed especially for short hauls . . . is changing the picture. It is economical on lines as short as 15 miles. With Type O thousands of lines will carry as many as 16 conversations apiece.

Type O is a happy combination of many elements, some new, some used in new ways. As a result, terminal equipment takes up one-eighth as much space as before. Little service work is required on location; entire apparatus units can be removed and replaced as easily as vacuum tubes.

Moreover, the new carrier system saves copper by multiplying the usefulness of existing lines. For telephone users it means more service . . . while the cost stays low.

Repeater equipment is mounted at base of pole in cabinet at right, in easy-to-service position. Left-hand cabinet houses emergency power supply. System employs twin-channel technique, transmitting two channels on a single carrier by using upper and lower sidebands. A single oscillator serves two channels.

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Stokes is FIRST in vacuum

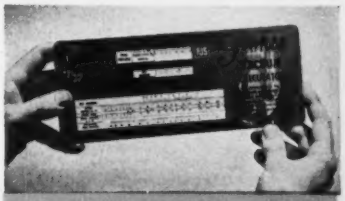
For many manufacturers in the high vacuum field the gap between the laboratory and the successful process has been a costly step . . . wasteful of time and money.

To vacuum engineering problems Stokes brings a wealth of experience in the design and manufacture, the installation and operation, of practical high vacuum equipment.

Stokes is the only manufacturer to design and make every element of its high vacuum equipment. Integrated design, centralized manufacturing responsibility and unparalleled experience are the unique extra value in Stokes High Vacuum equipment.

Stokes Vacuum Engineering steers a practical course through such design considerations as fluid flow, the effect of temperature and vacuum on structural elements, the selection of condensing surfaces, the introduction of mechanical motions to the vacuum chamber, and the operation of electrical equipment under high vacuum. The skilled application of these and other design factors is necessary for the successful use of high vacuum in metal coating and emission equipment, and in the production of zirconium, hafnium, titanium, magnesium and many other products.

Send for new Vacuum Calculator for rapid slide-rule calculations. Includes standard ABCD log scale. Also send for catalog 700, "Stokes Microvac Pumps for High Vacuum" with copious reference material.



Stokes vacuum equipment includes Microvac pumps, diffusion pumps, booster pumps, vacuum gages, vacuum furnaces, and equipment for vacuum drying, vacuum freeze-drying, vacuum impregnation, vacuum evaporation and vacuum distillation.

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METAL FABRICATION

considerably lengthened the short coils relative to popular 70-deg yoke designs. The long nylon coil form developed for a 52-deg yoke was adequate for 70-deg coils with nested ends allowing the effective deflection center to move forward on the picture tube neck.

Benefits of reduction in core-enclosed air-path reluctance (relative to conventional yokes) were not appreciated until excessive horizontal sweep sensitivity, relative to the byproduct of anode supply voltage with a single diode rectifier was noted. Reconnection of the yoke coils to reduce horizontal sweep sensitivity by using the shorter coils for horizontal produced three benefits: favorable energy storage to balance high voltage derivation with sweep for single diode rectifier systems, increased vertical sweep sensitivity and substantial improvement in focus uniformity due to field astigmatism compensation by 90-deg rotation of the yoke assembly.

Yoke Field Analysis

Yoke field analysis with a small probe-coil disclosed that the edge fields of conventionally wound coils were not fully in phase with the field at that instant at the yoke axis, following the retrace transient. This led to modulation of beam sweep and to objectional vertical bands of brightness modulation in most commercial television equipment.

Since this discovery, a fundamental cure has been evolved and successfully manufactured. The transient response of both units of each high-frequency coil pair has been equalized to minimize circulating harmonic currents superimposed on the desired sawtooth wave. This eliminates field-intensity modulation at the coil edges and avoids velocity modulation of the cathode-ray sweep.

Elimination of the usual balancing capacitor is now practical by winding such self-balanced coils to high impedance, of relatively fine wire (No. 35 or 36) and connecting such coils in parallel. Less than half of the copper usually needed for 70-deg yokes is shown to produce even improved performance and fully comparable focus in the reproduced picture.

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"impossible" requirement

FOR TECHNICAL CERAMICS?

These parts are enlarged approximately one and one half times

Many people are kind enough to say we're the first to try for any "impossible" technical ceramic. It's probably true that we've made more different sizes, types and shapes than anybody.

Through cooperation, and a little give and take on both sides, we've been able to make a lot of "impossible" ceramics. If you have an "impossible" requirement, let us know. We might be able to work it out with you. Anyway, we'd be caught trying.

We don't make a thing but technical ceramics. We've been doing it for over fifty years. It might pay you to give us first crack at anything in technical ceramics.

P. S. A couple of new plants in production now! On most things we can give you pretty fast deliveries.

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Production Techniques

Edited by JOHN MARKUS

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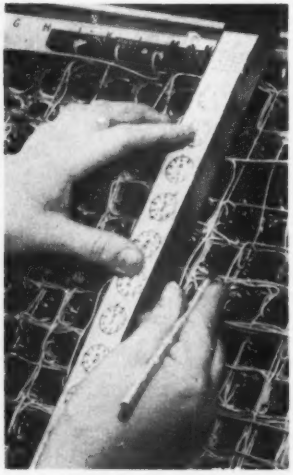
Connection-Checking Card



Use of checking card and probe for inspection of socket wiring

TO SPEED the checking of socket connections on an electronic calculator having over 200 tubes, a separate checking card is used for each vertical row of eleven sockets. Each card is made of heavy fiber on which is cemented a paper strip with checking data. The wires that should go to each terminal are drawn in their correct colors on the card, so that the operator can compare colors for an entire socket almost at a glance.

The checking card is held in position with the left hand, and a probing tool in the right hand is used for wiggling suspicious joints or dressing wires. The probing tool also has psychological value in improving the accuracy of inspection.

Checking cards are identified by letters corresponding to those imprinted on the chassis of the calculator. The technique has greatly improved the efficiency of a tedious inspection operation in the Poughkeepsie, N. Y. plant of International Business Machines Corp.

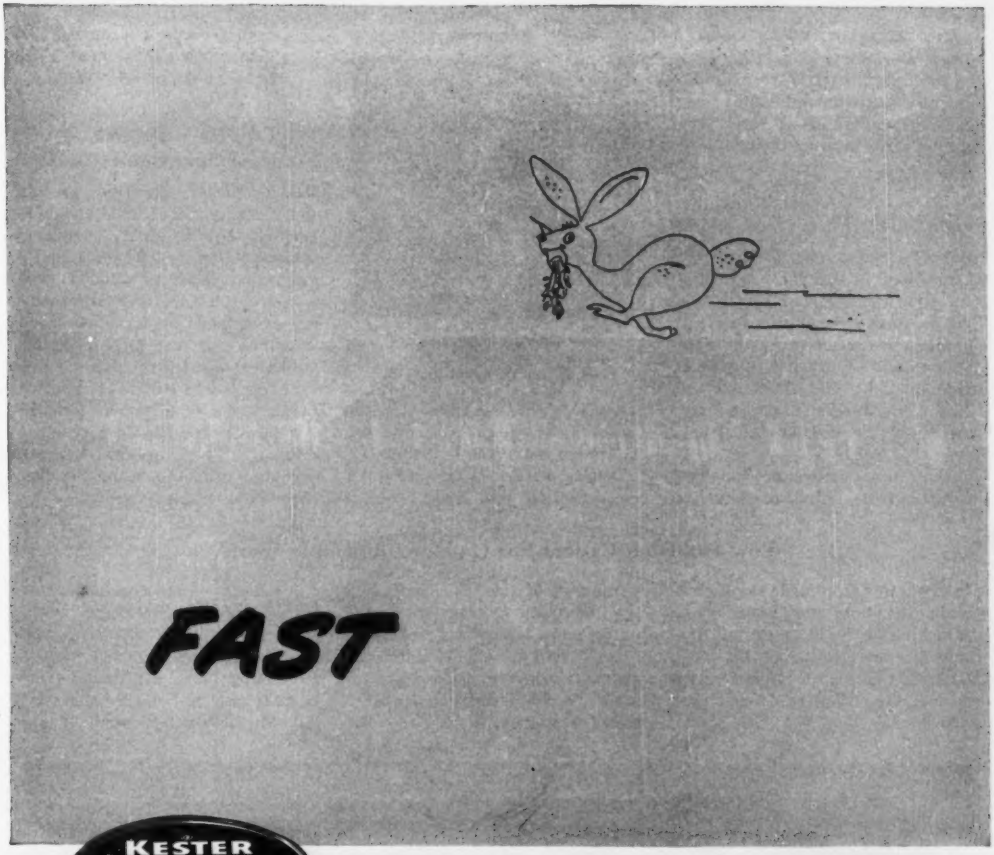
Coil-Winding Setup

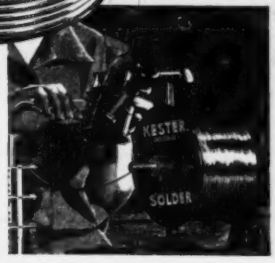
THE low-cost improvised winder for r-f grid coils, shown here, was developed by production engineers of DuMont's East Paterson, N. J. plant. A belt-and-pulley drive is used in combination with rheostat control of a fractional-horsepower electric motor to provide the desired headstock speed for the winding lathe. The spring-loaded tailstock slides and turns freely in a ball-bearing mount. Starting and stopping is by means of a foot-pedal switch. A counter on top of the headstock indicates total turns at a glance, and is crank-reset to zero after completion of each coil.

Ends of coils are fastened securely in place by applying beeswax with a pencil-type soldering iron.

Except for the reel of wire, the

Improvised setup for winding r-f grid coils, showing how wax is melted over end of coil with small soldering iron to anchor the lead





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entire assembly is mounted on a heavy steel plate, to maintain alignment of parts while retaining portability. A small aluminum dial-cord pulley mounted on a metal stud guides the wire from the reel to the coil.

Continuity Tests

A POWER supply chassis with indicator lamps is used to check the continuity of all four coils in a television receiver deflection yoke in one simple operation in the Television Receiver Division of Allen B. DuMont Labs., Inc., East Paterson, N. J. A different chassis-mounted test set is provided for each type of yoke.

Units ready for test are slid down a metal trough that rests on top of the bench. Units which pass the test are given another push down the trough to the next position.

Plugging deflection yoke unit into test set socket, cable for which runs under metal pass-along trough on bench

Testing merely involves plugging the deflection yoke cable into a socket that comes out of the test set and making one alligator-clip connection to the metal yoke frame.

Pliofilm Bags Protect Finished Subassemblies

IN THE military electronic production department of IBM's Poughkeepsie, N. Y. plant, completed subassemblies for electronic equipment are placed in pliofilm bags to keep out dirt and prevent scratching of finished surfaces. A large assortment of bag sizes is maintained in stock for this purpose.

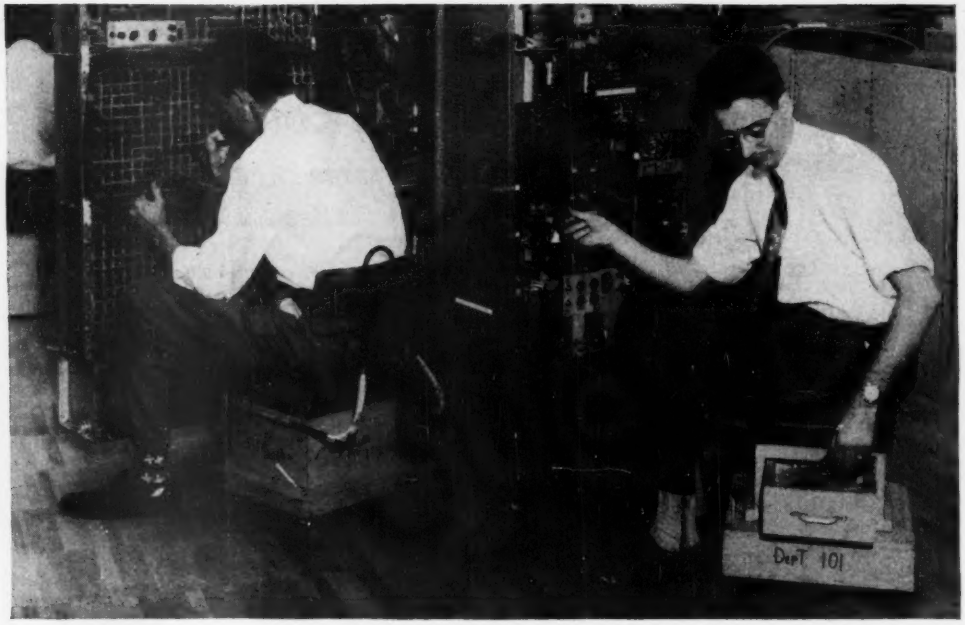
Larger covers made to particular shapes are used to protect finished commercial products during actual shipping. These are so designed that they can be used by the customer later as a dust cover.

Low Stools on Casters For On-Floor Assembly Work

INEXPENSIVE shop-made stools eliminate the need for kneeling or crouching on the floor during final assembly and testing of the large racks of electronic equipment used in the type 604 IBM electronic calculator.

One type of stool is essentially a wood box with four casters on the bottom and a leatherette cushion on top. A small drawer fitted into the box provides convenient storage for pliers, screwdrivers and other needed hand tools.

Another type has a back rest, supported by bent pipe attached to the base of the stool. The back rest may be removed when not wanted. Projecting parts of the pipe are taped to prevent them from scratching the finished cabinet of the

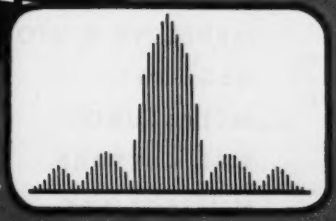


Rolling stools developed for work on rack-mounted equipment

The FIRST and still the only all-band direct reading SPECTRUM ANALYZER

10 MCS TO 21,000 MCS

Polarad's Model LSA Spectrum Analyzer is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an r.f. signal.



Outstanding Features:

- Continuous tuning.
- One tuning control.
- 5 KC bandwidth on fixed i. f.
- 250 KC to 25 MCS display at all frequencies.
- Tuning dial frequency accuracy 1%.
- No Klystron modes to set.
- Broadband attenuators supplied with equipment from 1 to 12 KMC.
- Frequency marker for measuring frequency differences 0-25 MCS.
- Only four tuning units required to cover entire range.
- Microwave components used latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Where Used:

Polarad's Model LSA Spectrum Analyzer is a laboratory instrument used to provide a visual indication of the frequency of distribution of energy in an r.f. signal in the range 10 to 21,000 MCS.

Other uses are:

1. Observe and measure sidebands associated with amplitude and frequency modulated signals.
2. Determine the presence and accurately measure the frequency of radio and/or radar signals.
3. Check the spectrum of magnetron oscillators.
4. Measures noise spectra.
5. Check and observe tracking of r.f. components of a radar system.
6. Check two r.f. signals differing by a small frequency separation.

Write for Complete Details

The instrument consists of the following units:

Model LTU — 1 R.F. Tuning Unit — 10 to 4000 MCS.
Model LTU — 2 R.F. Tuning Unit — 500 to 8000 MCS.
Model LTU — 3 R.F. Tuning Unit — 6440 to 14,500 MCS.
Model LTU — 4 R.F. Tuning Unit — 12,000 to 21,000 MCS.
Model LDU — 1 Spectrum Display Unit.
Model LPU — 1 Power Unit.
Model LKU — 1 Klystron Power Unit.

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Manufacturers of broadband microwave laboratory instruments.

Continuous Radioactivity Measurements

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CHEMISTRY
MEDICINE & BIOLOGY
GEOLOGY
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MINERALOGY

Type 1500-B Counting-Rate Meter.....$540

Range: *full-scale values of 200, 600, 2000, 6000 and 20,000 counts per minute — minimum rate readable on meter scale is 5 counts per minute*

Accuracy: *±3% of full scale*

Pre-amplifier: *built into hand probe at end of 6-foot cable — adapter permits use of either self-quenched or internally quenched counter tubes of any design*

Response: *Four response speeds for wider range of meter damping*

Counter Circuit Voltage: *continuously variable from 400 to 2,000 volts, and available at rear of instrument — can be read from 8-position switch and calibrated dial — means provided for standardizing voltage*

Output: *trigger circuit output — recorder jack on front panel*

Accessories Supplied: *plug for connecting recorder, counter tube adapter, line cord and spare fuses (counter tubes extra)*

Type 1500-P4 Beta-Gamma-Ray Counter Tube $40

Type 1500-P5 Beta-Gamma-Ray Counter Tube $50

Type 1500-P11 Probe Mounting Stand . . . $12.50

GR

equipment. All other parts that might bump a cabinet are wood or leatherette, and hence are not likely to scratch. These stools were developed at International Business Machines Corp.

Candle Flame Singes Whiskers on Wire

WHEN hard, tough fibres of woven insulation on wires are not completely cut by automatic stripping machines, workers at the Poughkeepsie electronic plant of International Business Machines Corp. use

Flame of candle burns off dangling strands of insulation

an ordinary candle to burn off the whiskers of cotton that remain. This prevents the insulating strands from impairing continuity of soldered joints. Burning proved much faster than the former practice of cutting with scissors.

Oil Can Applies Cement to Voice Coil

A SMALL oil can mounted upside down on a cement-applying fixture is used in Crosley's Cincinnati plant to apply a band of loudspeaker cement around a voice coil during the operation of assembling the voice coil and spider.

The voice coil is pushed on an arbor to a turned stop, then rotated under the spout of the oil can. Dur-

Method of mounting small oil can to apply cement in uniform-width band as voice coil is rotated on arbor of fixture

ing normal steady production the cement flows freely without being started. When starting up after lunch, a few squeezes on the side of the can clear the clogged spout.

Overhead Coat Hangers

DEAD space near the ceiling in production areas is used for hanging coats in the Cincinnati plant of the Crosley Division, Avco Mfg. Corp. This unique practice eliminates the

Crosley employee demonstrates how a coat is brought down from the ceiling

The Type 1500-B Counting-Rate Meter, with Geiger-Mueller Counter, is a complete precision instrument for the continuous visual, aural and graphic measurement of the rate of random radiation. It is basically a laboratory instrument rather than a field survey device.

Four response speeds control meter fluctuations for varying conditions — change in rate of count occurring in a fraction of a second can be recorded or measured accurately — high input sensitivity permits use of long cable to counter tube — calibration adjustment on panel — accuracy unaffected by ±10% changes in line voltage.

WITH THIS INSTRUMENT the geologist has observed the disintegration of mineral deposits to learn the age of the earth . . . the metallurgist has compiled valuable data on case hardening, welding and alloying . . . chemists have studied photosynthesis by tracer techniques . . . biologists have determined the effects of dosage of food or of medicine on a specific organ, and have applied irradiation selectively . . . the mineralogist has tabulated the relative abundance of natural radioactive isotopes.

Crystallography, oil surveying, glass and plastic manufacturing, combustion engineering design, ore assaying and turbulence research are but few of the many fields where measurement of radioactivity is proving very valuable.

The Type 1500-B Counting-Rate Meter is being used to drive the Esterline-Angus 5 ma model pen recorder . . . particularly useful for obtaining a permanent graphical record of changes in rate. Visual and aural indication of radiation intensity are provided by panel meter and loud speaker.

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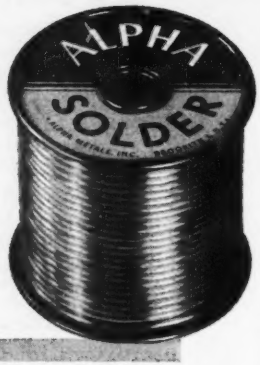

Guaranteed non-corrosive for radio, television, electronic and other electrical applications. No other solder works faster or easier . . . It provides greater fluxing uniformity and stronger smoother joints.

No activating chlorides or other chemical agents tending to produce acid conditions, toxic or sticky vapors, or latent corrosion.

Ideal where plated and/or oxidized parts must be soldered. Designed for use where faster fluxing is desirable.

CEN-TRI-CORE
PLASTIC
ROSIN-FILLED SOLDER

For those applications where a conventional rosin flux is required. For telephone and other critical soldering operations.

CEN-TRI-CORE's exclusive design guarantees rosin throughout the complete length of the wire. Eliminates rejects commonly encountered in the use of ordinary rosin core solders. CEN-TRI-CORE is faster fluxing: thinner walls between solder and rosin assure faster penetration of heat to the flux — requires less heat and guarantees maximum fluxing action of the rosin.

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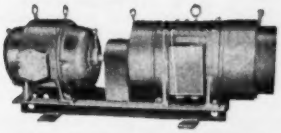
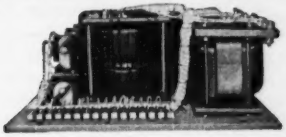
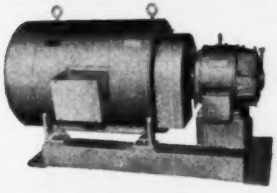


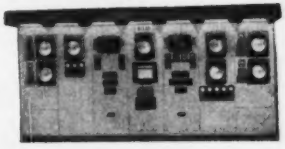
BOGUE MAGNETIC AMPLIFIERS FOR PRECISE CURRENT CONTROL WITHOUT MOVING PARTS



BOGUE 400 CYCLE POWER FOR LABORATORY OR PRODUCTION TESTING



PANELS FOR AUTOMATIC PROCESS CONTROL



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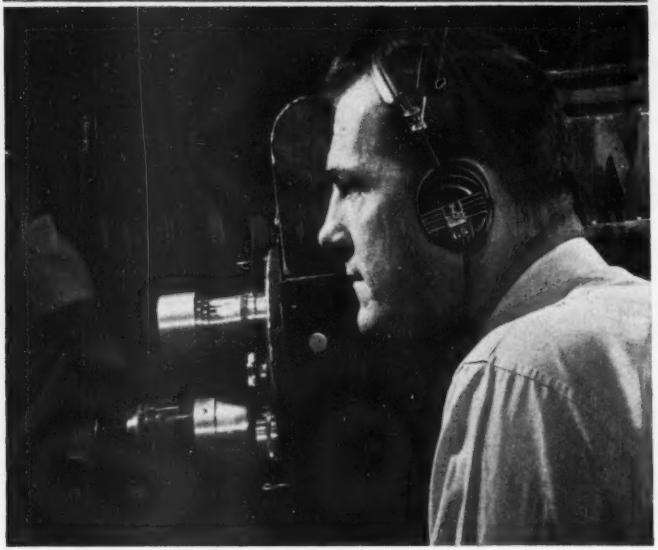

Brush headphones using the exclusive BIMORPH CRYSTAL drive element provide flat response, high sensitivity, and low distortion . . . are also engineered for comfort.

THE news flash "HARDING IS ELECTED" was spoken into an unwieldy microphone . . . picked up by crude radios . . . but the era of commercial broadcasting had begun.

The very next year, Brush began research on piezoelectric crystals, the nerve centers of many modern high quality acoustical instruments and equipment.

Brush pioneering has produced light, powerful headphones, replacing the heavyweights of yesterday. Smaller, more sensitive microphones have been developed. The original cumbersome hearing aids have become feather light and almost invisible.

Tomorrow is UHF television—new refinements in electrical circuits—new endeavors in electronics. Keeping pace with tomorrow is Brush, designing new dimensions in the quality of sound reproduction and transmission, working with research staffs everywhere to develop new products to meet the changing needs of America. Brush's business is the future!

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Magnetic Recording Equipment
Acoustic Devices
Ultrasonics
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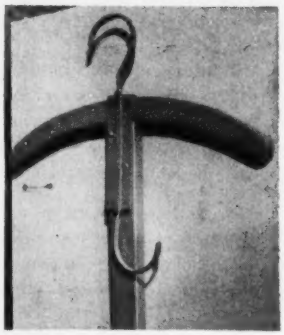


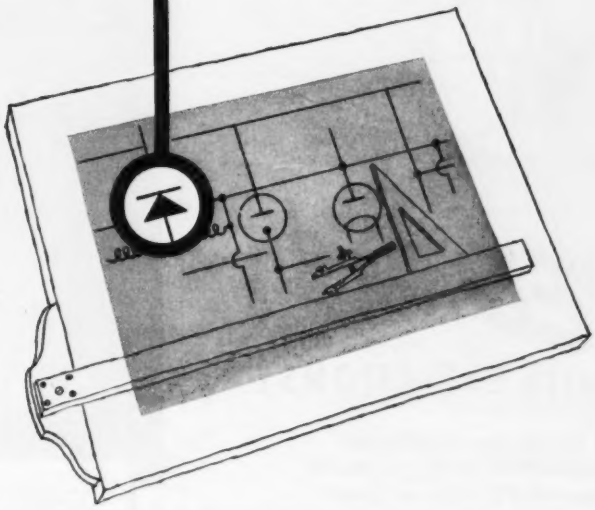
Closeup of overhead coat hanger, showing construction details. The double-hook piece is spot-welded to the U-shaped sheet metal brace

need for space-consuming locker rooms and in no way hinders use of floor space under the coats.

Overhead storage is made possible by a Crosley-designed long-handled hanger that hooks over a two-inch pipe suspended from the ceiling. The handle and the conventional curved crosspiece are of wood, fastened together by stove bolts and a U-shaped piece of sheet metal. The hook, made from $\frac{1}{4}$ by $\frac{3}{4}$-inch soft iron, is spot-welded to the sheet metal. An additional hook

New chair for assembly-line workers, showing compartment for storage of personal property

Bradley will do the engineering for you on rectifier specifications



We have selfish reasons for making this offer. Experience has shown that we save time in our own engineering, give the customers a better rectifier and more often than not deliver the production item at a lower cost than expected. We know that customers so served come back again and again.

Why not make sure that your rectifier specifications are the stiffest you can set for the intended application and for the price per unit you wish to pay. You can be sure by letting Bradley handle your rectifier requirements – the tough ones especially – from the very start. Simply tell us what your application needs are and we will draw up the specifications.

You will not only save valuable engineering time, but you will get the right rectifier more promptly and in all probability at less cost. In addition, our exclusive vacuum manufacturing process assures production rectifiers that are true to rating, built precisely to specifications.

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BRADLEY RECTIFIERS for PERFORMANCE AS RATED

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without grinding or finishing

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Single pole

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Single pole and double pole
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These Choppers convert low level DC into pulsating DC or AC so that servo-mechanism error voltages and the output of thermocouples and strain gauges, may be amplified by means of an AC rather than a DC amplifier.
They are hermetically sealed, precision vibrators having special features which contribute to long life and low noise level.

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60 cycles

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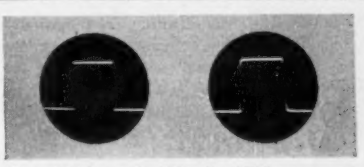
RCA WO-88A...

A new 5-inch scope with "picture-perfect" square-wave response



Unretouched photographs of 60-cycle and 50 Kc square waves reproduced on screen of WO-88A. Note fast retrace.

FEATURES—

- Direct-coupled, push-pull, two-stage vertical amplifier; push-pull horizontal amplifier.
- Frequency-compensated and voltage-calibrated attenuators.
- Front-panel source of 1-volt peak-to-peak calibrating voltage.
- Graph screen scaled directly in peak-to-peak voltage.
- Metal shield enclosing CRT gun to minimize hum-pickup from stray fields.
- Extra fast sweep-oscillator retrace.
- Built-in 60-cycle sweep with phasing control.

SPECIFICATIONS—

- Deflection Sensitivity: (vertical amplifier) 25 rms millivolts or better per inch.
- Vertical Amplifier Frequency Response: Flat from dc to 100 Kc; within —3 db at 500 Kc; within —10 db at 1 Mc.
- Input Resistance and Capacitance: 10 megohms and 9.5 uuf with WG-216B Low-Capacitance Probe.
- Sweep-Circuit Frequency (four ranges): 15 cps to 30 Kc.
- Square-Wave Response: Negligible tilt and overshoot.
- Power Supply: 105/125 volts, 50/60 cycles.
- Size 13½" high, 9" wide, 16½" deep. Weight only 25 lbs (approx.).

New WG-216B Low-Capacitance Probe gives the WO-88A an overall input resistance of 10 megohms shunted by less than 10 uuf.

The WO-88A combines the features required for TV receiver servicing, and the high stability and ruggedness essential for continuous production-line duty.

The outstanding feature of the WO-88A is its remarkably true square-wave response, obtained by adequate band-width, negligible phase shift, and a complete absence of peaking circuits. Vertical and horizontal sync pulses, as well as other complex wave forms, are reproduced with fidelity characteristic of expensive laboratory instruments. Furthermore, uniform frequency response is maintained over the entire range of the attenuators.

The two-stage dc vertical amplifier has more than enough gain for all usual applications. Moreover, all of the gain is useable because the input circuits are shielded against extraneous noise and hum right out to the probe tips. Push-pull circuitry in both stages of the vertical amplifier minimizes "line bounce"; and direct coupling provides instantaneous "recovery" time.

For operating convenience, the controls for push-pull balance, astigmatism adjustment, and interstage dc coupling are accessible from outside the cabinet.

Voltage measurements and waveshape observations can be made simultaneously with the WO-88A. A front-panel terminal provides a 1-volt peak-to-peak reference voltage; the green graph screen is scaled in peak-to-peak voltage divisions, which are multiplied by the settings of the step attenuator to determine the voltage.

The WO-88A incorporates other quality 'scope features such as "plus" and "minus" sync, 60-cycle sweep and phasing, and a shield around the CRT gun.

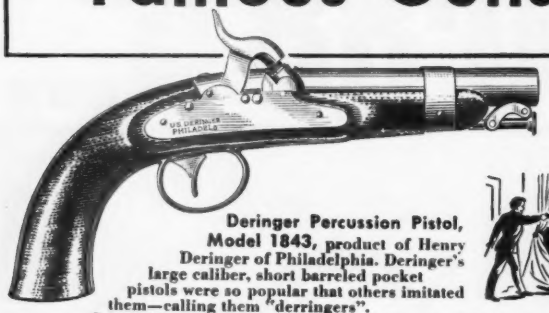
For complete details on the WO-88A, see your RCA Test Equipment Distributor, or write RCA, Commercial Engineering, Section JX-42, Harrison, New Jersey. TMK. ®

RCA

RADIO CORPORATION of AMERICA

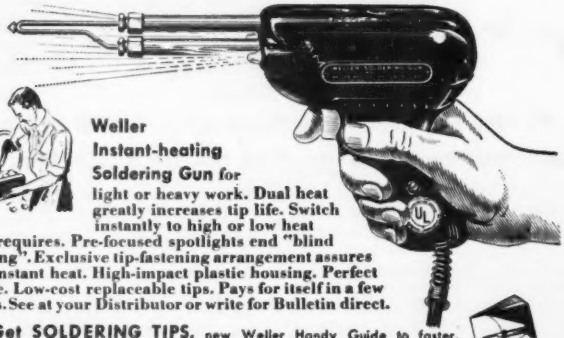
TEST EQUIPMENT **HARRISON, N.J.**

Famous Guns



Deringer Percussion Pistol, Model 1843, product of Henry Deringer of Philadelphia. Deringer's large caliber, short barreled pocket pistols were so popular that others imitated them—calling them "derringers". John Wilkes Booth used a Deringer to assassinate Lincoln.

Trap or Doorjamb Pistol, Caliber .31, made by North & Couch, Middletown, Conn. This lethal little device protected householders against burglars. Fixed to the doorjamb, with a cord running from muzzle rod to door, the pistol fired all its barrels into any intruder.



Weller Instant-heating Soldering Gun for light or heavy work. Dual heat greatly increases tip life. Switch instantly to high or low heat as job requires. Pre-focused spotlights end "blind soldering". Exclusive tip-fastening arrangement assures full, constant heat. High-impact plastic housing. Perfect balance. Low-cost replaceable tips. Pays for itself in a few months. See at your Distributor or write for Bulletin direct.

Get SOLDERING TIPS, new Weller Handy Guide to faster, easier soldering. 20 pages fully illustrated. Price 10c at your Distributor or order direct.

Weller BETTER FROM GRIP TO TIP!

SOLDERING GUNS 806 Packer Street, Easton, Pa.

The Finest Soldering Tool for the Finest Craftsmen

is formed at the lower end, on which umbrellas and other personal belongings can be hung.

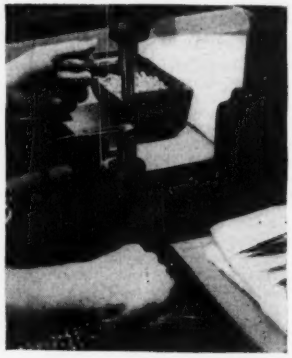
With this arrangement, each assembly-line workers' coat is only a few steps back of her bench. This reduces considerably the time otherwise spent in going to locker rooms to get things from coat pockets. Overhead storage also reduces the possibility of theft, as pockets are well out of reach and a person lifting down somebody else's coat to get into the pockets would be in plain sight of assembly-line workers.

The rods are painted grey, with a few inches of the lower end a bright red. The red serves to warn the cleaning crew against bumping their heads on empty hangers at night.

A new Crosley-designed chair for assembly-line positions contributes further to the needs of workers by providing a compartment underneath for storage of purse, lunch, working shoes and other small personal belongings. Again theft is minimized, and bench appearance is greatly improved by keeping personal belongings out of sight.

Magnet Holds Pointer on Riveting Machine

IN THE operation of flaring a bushing after insertion in a radio dial pointer, many rejects formerly occurred because the operator could



Alnico permanent magnet holds dial pointer in correct position on mandrel of riveting machine, leaving both hands of operator free to actuate the two safety controls that start the machine

1922
Close Tolerance Mica Capacitors
1929
Halowax Capacitors
1930
Dry Electrolytic Capacitors
1940
High and Low Temperature Electrolytic Capacitors
1947
Aerolene Impregnated Capacitors
1951
High Temperature Metallized Paper Capacitors
and now...
ANOTHER MAJOR ACHIEVEMENT
IN CAPACITOR DEVELOPMENT...
in 1952
AEROFILM*
Capacitors
The development of Mylar** polyester film by
Du Pont chemists and its adaptation as a capacitor dielectric
by Aerovox engineers, presents challenging potentialities
in the field of electronic capacitors.
Known as Aerofilm Capacitors, these latest components permit
higher operating temperatures without corresponding increase
in size, as well as unusually high insulation resistance.
Both gains mean much to the designers of tomorrow's
fantastic weapons and again to peaceful electronic applications.
Thus in 1952 Aerovox auspiciously embarks upon its
fourth decade of capacitor craftsmanship.
*Aerovox Trade Mark
**Du Pont Trade Mark
for polyester film
AEROVOX Capacitors
AEROVOX CORPORATION
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Tips on Cutting Costs in Ordering Fasteners

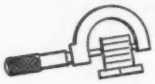
You can avoid unnecessary delays and costly misunderstandings by checking the following points when inquiring about or ordering fasteners.

DO

Specify all allowable tolerances —indicate whether all PLUS, all MINUS, or PLUS and MINUS.

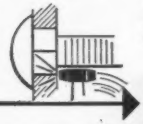
Submit sketch if possible (may be rough as long as dimensions are clearly shown).

Submit samples if possible.



Specify as liberal tolerances as intended use will permit. (Close tolerances increase costs.)

If any special allowance is to be made for subsequent plating the thickness of plate should be specified.



Where square shoulders are to be subsequently staked over, this fact should be so stated.

DON'T

Don't specify dimensions in decimals when fractional dimensions are sufficient.

Don't specify lengths in units finer than necessary.

REPRINTS *of this chart are available on request for use in drafting and purchasing departments.*

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16 CHAPTERS COVER

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- antennas
- **audio**
- **cathode-ray tubes**
- components
- **electronic music**
- **filters**
- **measurements**
- microwaves
- oscillators
- power supplies
- propagation
- pulses
- receivers
- **transmission lines**
- transmitters

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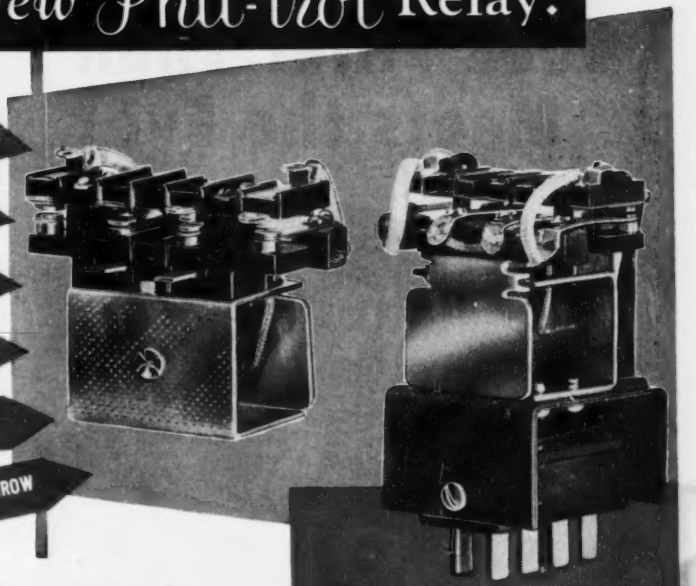

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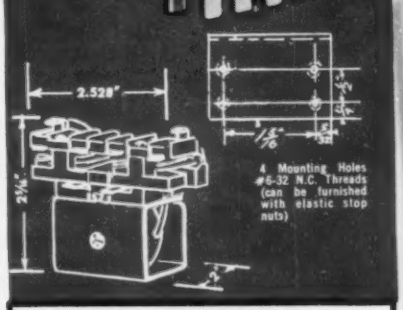

Write for detailed Data Sheet and copy of latest Phil-trol Relay Catalog

Phil-trol PRODUCTS

PHILLIPS CONTROL CORPORATION

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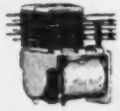
OTHER PHIL-TROL RELAYS:

Power Relay Type 27QA



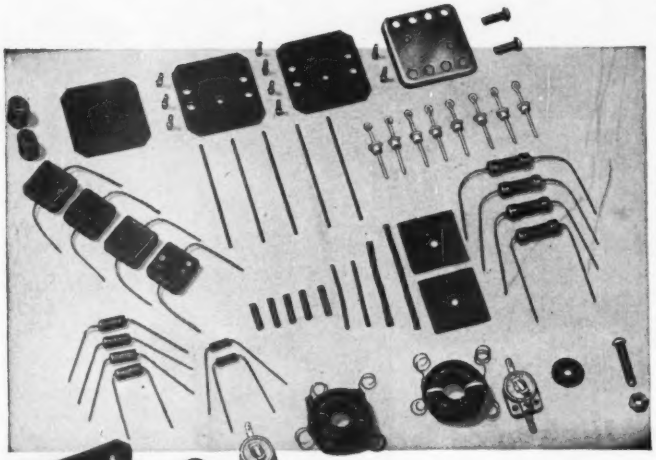
Miniature Telephone Type 40A

Telephone Type 2QA

Hermetically Sealed Type 20366-1

Hermetically Sealed Type 40015

There's More to a Good Filter Than Meets the Eye!



All of these 66 parts are from a single B&W Toroidal-coil type discriminator only 1¾" square by 3½" long exclusive of terminals!

Throughout, the job is one calling for precision components plus a wealth of engineering "know how" in producing and assembling them for maximum performance and effectiveness.

Like all other B & W Special Components, the one illustrated here was designed and produced for a specific application—in this instance a critical military use.

FILTERS

In addition to "tailor-made" discriminators, B & W offers a complete line of performance-proved filters including high-pass, low-pass, band-pass and band suppression types.

TOROIDS

B & W Toroidal Coils of various styles and sizes are available in a wide range of inductance values in open, shielded, potted and hermetically sealed types.

B&W **Barker & Williamson, Inc.**

237 Fairfield Ave., Upper Darby, Pa.

not hold the pointer precisely at right angles to the bushing and at the same time safely actuate the two starting controls for the press.

The problem was solved in the Cincinnati plant of Crosley Division by mounting a small permanent magnet on the mandrel of the machine, and taping onto this a V-shaped piece of iron which positioned the pointer at exactly the correct angle. The magnetic attraction is sufficient to hold the plated iron pointer rigid despite the jar as the press first hits the bushing.

Wire-Plugging Tools

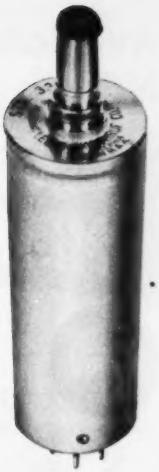
WIRES with AMP insulation-piercing plugs are pushed into mating pin jacks with two types of tools during assembly of electronic business machines in the Poughkeepsie, N. Y. plant of International Business Machines Corp., to give secure joints without use of solder.

At working positions where a large number of such connections are made, a pneumatic plugging tool

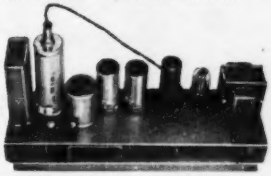
Using air-operated tool to push plug-tipped wires into tiny jacks

A lot of engineering for a Component!

and every Speedomax user benefits by it!



Converter's job in Speedomax instruments is to receive the (often very small) direct current signal which is related to the temperature, stress pH or other condition being measured, and produce an alternating voltage. This output is amplified, and then directs the balancing system to measure, record, and if desired control.



Good engineering shows in this Amplifier's thorough filtering, high impedance, and plug-in connection to the rest of the Speedomax.

Good engineering shows in this Slidewire's non-inductive winding and in absence of any flexible leads which might form inductive loops.

Good engineering shows in this balancing motor's small size, and in its torque ample to operate accessory control and signalling fitments.

• The operating precision of the thousands of Speedomax Recorders and Controllers which serve industry and science begins with the engineering of components like this Converter. Our specifications apply at all stages—all the way back to the plants which make metals, insulation materials, etc., for us. These specs represent also the best thinking of our suppliers' engineers. The resulting materials are thus quality-controlled for us—and us alone.

From these materials our engineers tell our factory how to make converter parts to truly tight specifications. Some parts require principally flatness, or elasticity, or dimensional stability. Reeds need correct natural frequency. Many parts of course combine various needs; each gets its requirements.

Life tests show Fidelity and Stamina. Ingenious and often original design creates from these parts a converter with noise level equivalent to only 0.2 microvolt in an emf potentiometer circuit. And this fidelity promotes accurate measurement and control.

Running on life tests since 1948, present-model converters are today still well inside performance tolerances. Such a run equals 21.9 years of 8-hours-a-day, 200-days-a-year-service—or 1.9 years more than the present age of the first Speedomax.

This kind of engineered performance is also built into the amplifier, slidewire, motor and scores of other exclusively Speedomax parts. It's at your service whether you want to control a laboratory furnace, plot an X-Y function, or record the facts about atoms or molecules. Call on L&N application engineers in selecting the range (from among thousands) and measuring circuit (from among over 2300) to meet your needs. Write our nearest office, or 4979 Stenton Avenue, Philadelphia 44, Pa.

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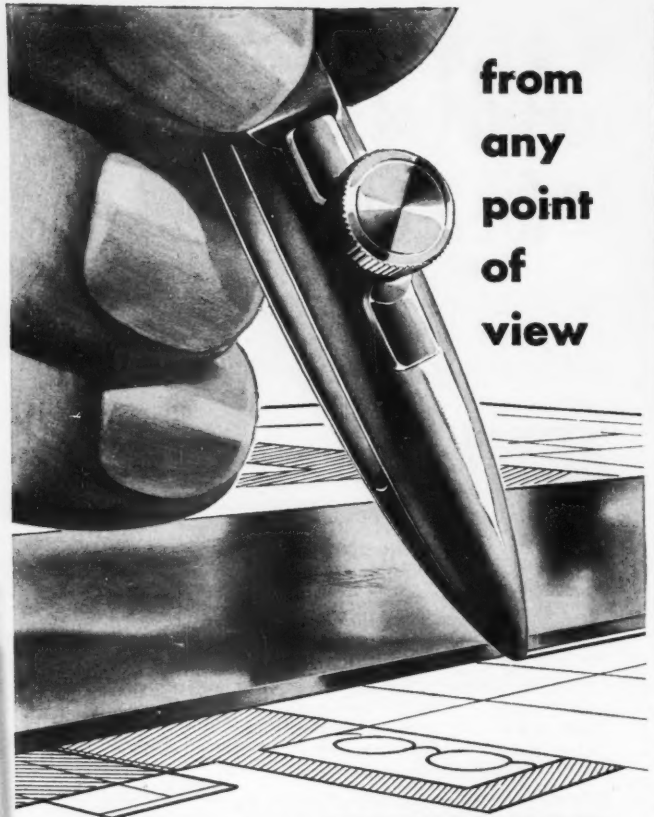

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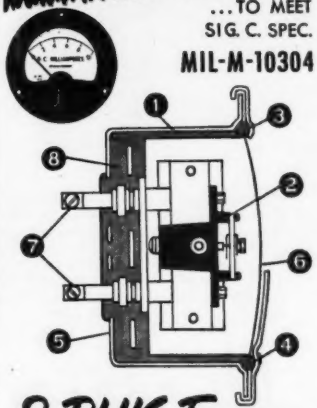

8 PLUS Features

EXTRA "RUGGEDIZED" FEATURES

1. Meter movement shock-mounted and housed in rubber-lined case.
2. Meter movement supported by die-cast frame for greater strength and increased accuracy.
3. Observation window rubber grommeted and sealed to rubber lining of case—providing hermetical seal of high dielectric materials.
4. Non-rigid mounting of observation window with rubber grommet increases resistance to shock.
5. Each meter designed and built by SUN to highest quality and precision standards.

EXTRA INSTALLATION ADVANTAGES

6. Slight convexity of observation window reduces chance of accidental breakage during installation or shipment.
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8. Breakage or damage in wiring is reduced through non-rigid mounting of terminals and use of flexible interior conductors.

Building rugged electric meters is not new to SUN . . . For over 20 years, the automotive industry has depended on SUN as one of the largest "D'Arsonval-type" meter manufacturers—to produce rugged, tough meters that will stand up under the abuse and rough handling of portable field instruments used in automotive repair work. SUN "Ruggedized" Meters not only meet Specification MIL-M-10304 (Sig. C)—but also embody many *plus* features that make installation easier, faster and help prevent assembly or shipping damage. Complete data bulletin on SUN "Ruggedized" Meters available on request.

SUN "Ruggedized" Meters are available as D-C Volt Meters, Ammeters, Milli-ammeters and Micro-ammeters and also may be ordered as rectifier type A-C instruments. 6060-O

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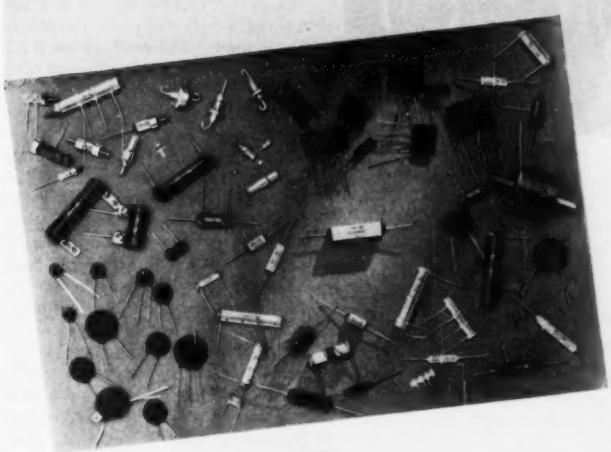
Guided missiles that can chase an enemy plane for miles... and eventually catch and destroy it...are just one of the many "fantastic weapons" which electronics have contributed to the defense of our nation. And here, as in all other phases of this great new science, you'll find **Hi-Q** components valued for their dependable performance, long life and rigid adherence to specifications. Whether it be disk capacitors...tubulars, plates or plate assemblies...high voltage slug types... trimmers, wire wound resistors or choke coils...you can count on the **Hi-Q** trade mark as a guarantee of quality in ceramic units. And you can likewise count on **Hi-Q** engineers for skilled cooperation in the design and production of new components to meet specialized or unusual needs.



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...may be had with axial leads and a specially developed endseal as shown above, or with conventional leads. **Hi-Q** tubulars are available in a complete range of by-pass, coupling and temperature compensating types as well as in an HVT line developed specifically for use on the relatively high pulse voltages encountered in the horizontal sweep and deflection sections of television circuits. Whatever your needs for tubular capacitors or other ceramic components, you are invited to consult **Hi-Q**.

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6. Protective fungi resistant acetate label.
7. Rigid hot solder coated brass terminals for easier soldering.

MEPCO, INC.,
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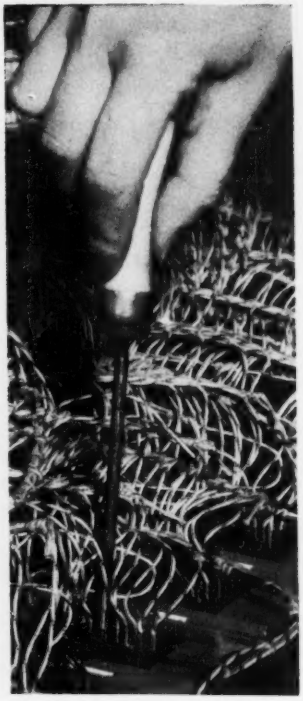


Hand tool for plugging wires into jacks

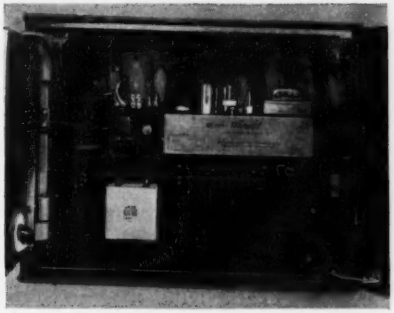
is used. The tool in this is a rod having a hole drilled in its end to the diameter and depth of the thick part of the plug. A milled slot runs lengthwise into this hole. In use, the tool fits over the plug, with the wire coming out of the slot. After inserting a plug-tipped wire in its correct jack loosely by hand, the operator holds the tube over the jack and operates the thumb valve. The resulting vibratory action forces the plug into the jack smoothly in a few seconds.

At working positions requiring only occasional plugging in of wires, a hand plugging tool having a plain screwdriver-type handle is used. Here the operator must have sufficient strength to push in the plug, since force is required. The plugs are made by Aircraft Marine Products Co., Harrisburg, Pa.

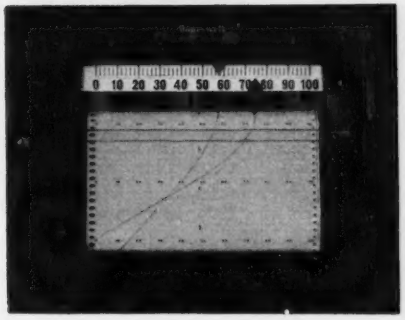
Solder Holder

SIMPLE metal holders attached to the undersides of benches keep rosin-core solder within reach of assembly-line operators at all times

Important to Engineering, Research & Testing



Internal view showing amplifier and damping circuit components.



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For accurate records of rapidly changing variables

• Now you can accurately record, on a wide chart and on a *null-balance instrument*, full scale signals which vary as rapidly as 20 cycles per minute. Signals with a peak to peak amplitude of 10% of scale can be reproduced at variations up to 3 cycles per second.

The instrument develops a pen speed that traverses its eleven inch graduated chart in *one second!* It has chart speeds up to 4 inches per second—20 feet per minute. It incorporates an adjustable damping circuit . . . has a motor driven reroll mechanism to maintain constant tension on the chart . . . and is adaptable to the measurement of practically any d-c signal.

• THE *ElectroniK* DUPLEX RECORDER

Simultaneously records two independent variables

ON ONE CHART

• On a single chart, the *ElectroniK* Duplex Recorder provides a clear, easily read record of the measurement of practically any combination of two independent variables. A "natural" for such applications as atomic energy, stress analysis and acoustics . . . this instrument is particularly useful in before and after comparisons made by recording a measurable characteristic of a substance as it enters and emerges from a processing stage or reaction.

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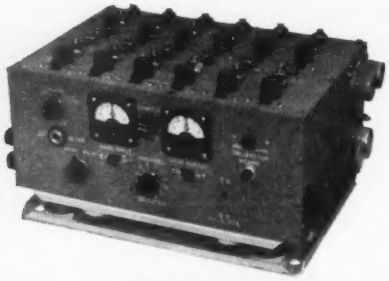
Century MODEL 1809
BRIDGE CONTROL UNIT
FOR VIBRATION AND STRESS ANALYSIS



Designed as a companion unit to Century's famous Model 409 Oscillograph, the Model 1809 Bridge Control Unit is the latest addition to Century's line of industry-standard vibration and stress analyzing equipment. Packaged in a small, compact space, the unit contains all of the facilities necessary for use with 12 channels of resistance strain gages or bridge-type transducers. Where used with the Model 409 Oscillograph, it is necessary only to connect strain gages and power source to have a complete stress-strain measuring and recording system, small and rugged enough to be placed in an aircraft wing tip or guided missile warhead.

FEATURES:

Size: 4½" x 7" x 11".

Weight: 10½ pounds.

Aluminum case.

Up to 12 channels.

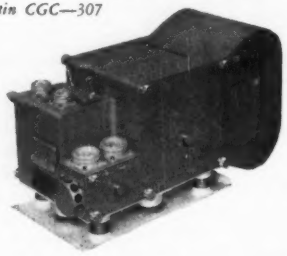
For any resistance strain gage or bridge-type transducer.

May be used with direct indicating instrument.

Power: Control unit, 22-28 Volt D.C.
Strain gage, 6-28 Volt D.C.

Write for Bulletin CGC—307

MODEL 409 OSCILLOGRAPH



The Century Model 409 Oscillograph has been designed for recording data where space and weight requirements are limited. The Oscillograph has been tested to record faithfully while subjected to accelerations up to 20 G's.

FEATURES:

Size: 5" x 6 13/16" x 11 15/16".

Weight: 13 pounds.

Cast aluminum case.

Paper speeds variable ½" to 6" and 2" to 24" per second.

Detachable daylight loading magazine with a capacity of 3⅝" x 100' paper.

2 to 14 individual channels.

Trace identification.

Trace viewing.

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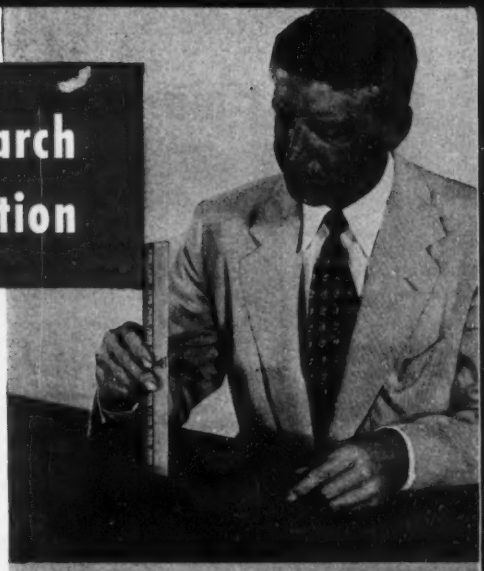
- Automatic Controls
- Experimental Laboratories

Write for details

KENYON TRANSFORMER CO., Inc.
840 Barry Street, New York 59, N. Y.

National Engineering Research finds the *economical* solution



Phenolite postformed expansion joint cover.

The problem:

to insulate a 5 kilovolt, 1500 ampere bus bar installation

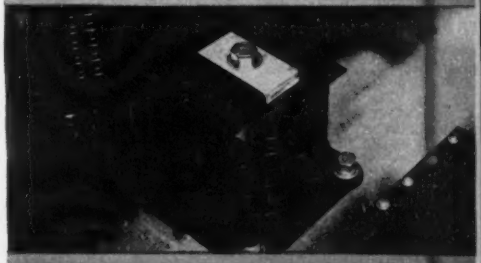
Recently I-T-E Circuit Breaker Company of Philadelphia had the problem of *completely* insulating 5 kilovolt, 1500 ampere 3 phase bus bar units for an Atomic Energy Commission installation. It was simple enough to insulate the bus bars with oval Phenolite tubing. But, to completely insulate the bus supports and expansion joints was a real problem. I-T-E's engineers showed us what they wanted . . . postformed Phenolite insulating covers . . . drawn deeper than anything we had ever attempted. Our engineers tackled the problem.

Expansion joint with and without Phenolite insulating covers.

The solution:

Phenolite Grade X-114A postforming material and National's technical "know how" in the design of forming dies

Perhaps *your* problem doesn't involve the insulation of 5 KV, 1500 ampere bus bars. But maybe you have an insulating problem where National can give you some real help in solving how to do your certain job economically. Write us, our engineering service is immediately available.

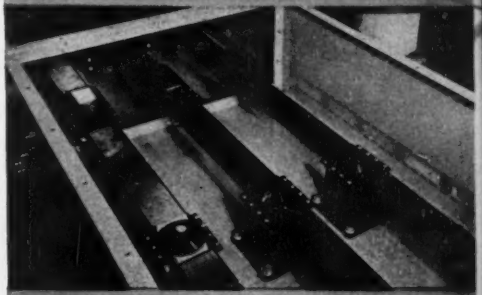


Bus support with and without Phenolite insulating covers.

National Laminated Plastics
nationally known—nationally accepted

PHENOLITE Laminated PLASTIC

The perfect insulation material for high and low voltage applications, Phenolite possesses an unusual combination of properties. It has great mechanical strength and high resistance to moisture; ready machinability; is about one-half the weight of aluminum. Standard colors are natural, black, chocolate; mirror, semi-gloss and dull finishes. Sheets, Rods, Tubes, Special Shapes.



Completed installation, showing Phenolite insulation for bus bars, supports and expansion joints.

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Wilmington Delaware

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When you have a marking problem, ask Markem about it. Send a sample of the item to be marked and details of your needs. Markem engineers have worked out practical solutions for many manufacturers. MarkeM Machine Company, Keene 5, N. H.

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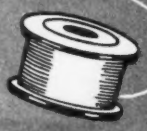

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- Sizes: 10 through 50 A.W.G.

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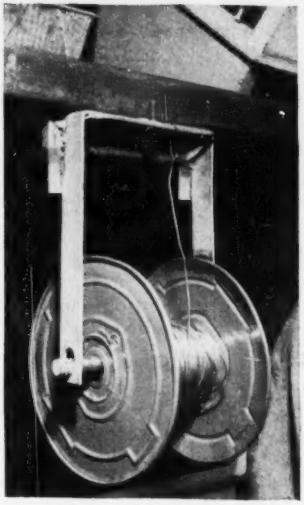


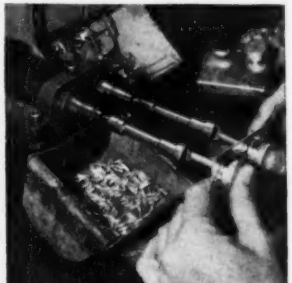
Metal holder for solder reel

in Emerson's Jersey City television plant. The metal shaft for the reel of solder has a deep turned groove in one end to prevent it from sliding out of the U-shaped frame. To change reels, the grooved end of the shaft is lifted slightly, so it can be slid out of the hole in the frame.

The end of the solder is brought up through a hole in the top of the holder. This prevents the end from dropping to the floor out of reach.

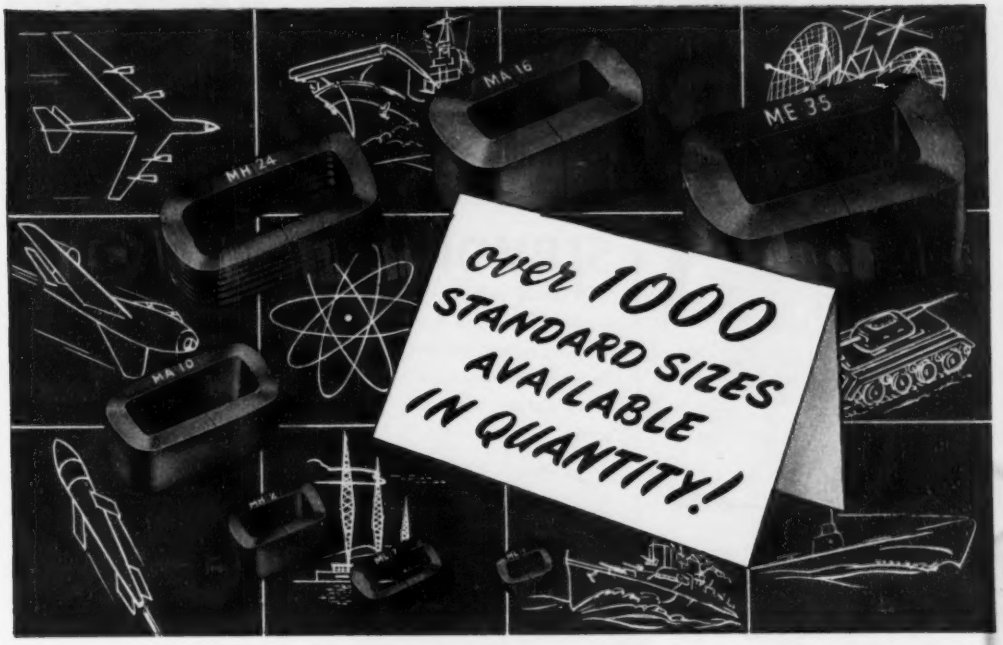
Dual Air Guns Speed Subassembly Work

ASSEMBLY of two television controls on a small subpanel is speeded in Crosley's Cincinnati plant by mounting two air-operated socket



Dual air gun setup for driving nuts on vertical linearity control and height control for tv set

MOLONEY *HiperCore* ELECTRONIC CORES



Over 200 manufacturers of electronic products for ultimate use by the U. S. Government are now using Moloney HiperCore Cores for Electronic Transformers.

More than 1000 standard sizes are available in quantity to such manufacturers in thicknesses from 1 mil to 12 mil and in widths from ¼". HiperCore Electronic Cores are of wound core construction using oriented-grain, cold-rolled silicon steel which results in greater flux carrying capacity and lower losses than other type cores of comparable sizes. These smaller, lighter cores perform better and permit increased production by savings in assembly time.

Rigid control of core production permits these cores to test well within industry tolerances. Table at right shows typical test requirements. Special tests for specific operating conditions are made when desired.

Write today for further information.

ME-52-27

STANDARD TESTS

All 12 mil cores are tested for core loss (true watts) and exciting volt-amperes (apparent watts) at 60 cycles. 4 mil cores are tested at 400 cycles. Following table gives maximum test values. Average values are approximately 20% less than maximum.

	12 Mil—60 Cycle @ 15000 gauss	4 Mil—400 Cycle @ 10000 gauss
Core Loss (TW)	0.95 x lbs.	4.4 x lbs.
Exciting Volt-Amps (AW)	1.75 x lbs. + 8.25A*	5.0 x lbs. + 18.8A*
* A = Gross Area of core face in Sq. In.		

All 2 mil cores are tested for pulse permeability by using a 2 microsecond pulse width at 400 P. P. S. and maximum flux density of 10000 gauss. The minimum permeability will be 500.

All 1 mil cores are tested for pulse permeability by using a 0.25 microsecond pulse width at 4000 P. P. S. and maximum flux density of 3000 gauss. The minimum permeability will be 175.

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Constant Laboratory control over raw materials, work in process, and finished product assures dependable performance.

Check the advantages of Carol quality and service in solving your wiring problems. Write us about those problems *today!*

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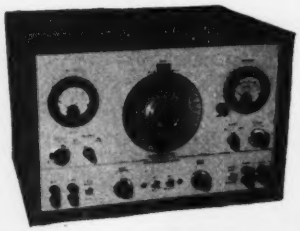

Test analyzer for use in development and PRODUCTION of SERVOMECHANISMS and PROCESS CONTROLS. Measures FREQUENCY RESPONSE, PHASE SHIFT 0.1 to 20 CYCLES SINE WAVE, SQUARE WAVE, MODULATED CARRIER, 50 to 800 CYCLES.

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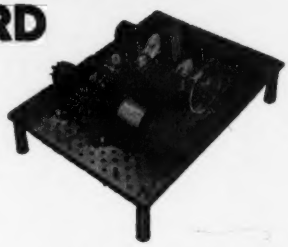

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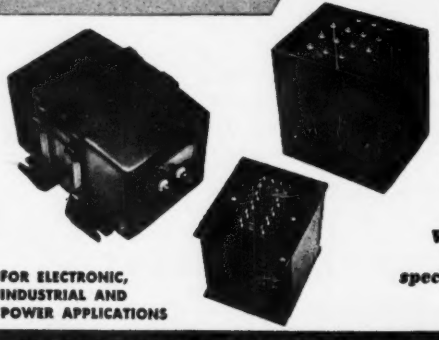

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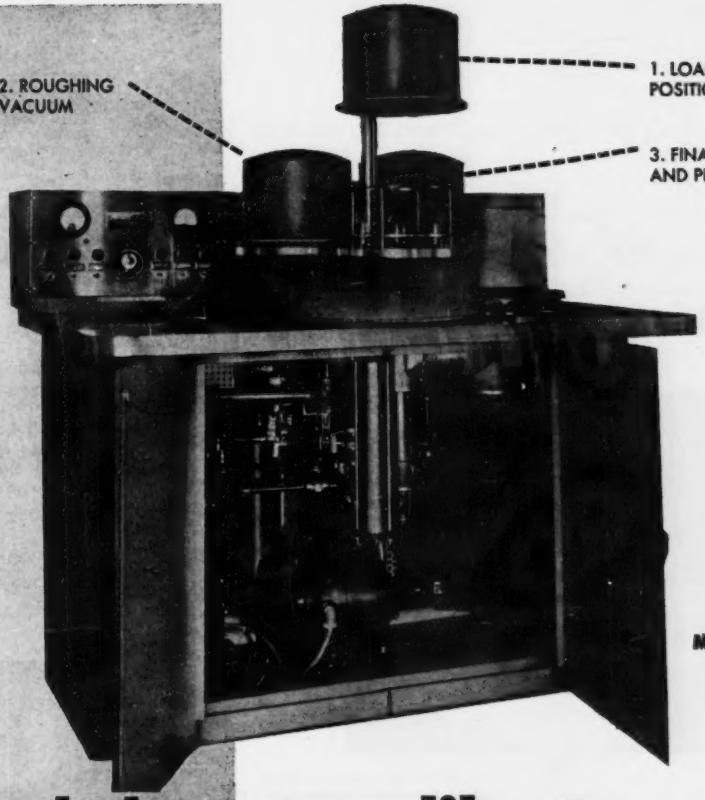

Model 3

here's how to calibrate crystals accurately, quickly . . .

Model 4

Manifold type final frequency calibration unit, type FFO. This unit is engineered to calibrate one crystal every 15 seconds with vacuum of less than ½ micron. Designed for bench mounting in multiple units, this model is available for immediate delivery designed for either manual or electric valve operation. Although possible to base plate with this machine, it was primarily designed for final frequency calibration only. This equipment does not include frequency measuring instruments.

Production quantities of quartz crystal oscillator plates can be brought to precise frequencies efficiently and accurately with the equipment shown above. This unit, Model 3, deposits thin, uniform films of metal (gold, silver, aluminum, etc.) on crystal blanks, glass, metal or ceramics . . . in both base plating and final frequency operations for crystal manufacture.

An important feature of Model 3 is the triple turret design. This turret, indexing to 3 positions, permits the simultaneous operations of 1. loading-unloading, 2. initial evacuation, 3. final evacuation and plating. Completion of exhaust cycle in less than 2 minutes is accomplished by use of two mechanical pumps and two oil diffusion pumps. These exclusive features are but a few reasons **why nine out of ten crystal manufacturers today use CONSTANTIN equipment.**

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Complementing the rich, unwavering tones of a recorded masterpiece, is the uniformly smooth, quiet operation of the General Industries *Smooth Power* Phonomotor. Unique drive mechanism assures accurate turntable speed at 33⅓, 45 and 78 R.P.M.

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THE GENERAL INDUSTRIES CO.
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wrenches side by side rigidly on the bench. The operator merely places the controls in their panel holes, places Pal nuts in the wrenches, then pushes the shafts of the controls into the hollow shafts of the wrenches, to spin both nuts tight simultaneously. The wrenches are of the clutch type, hence they start as soon as the threaded bushings of the controls are pushed against the nuts.

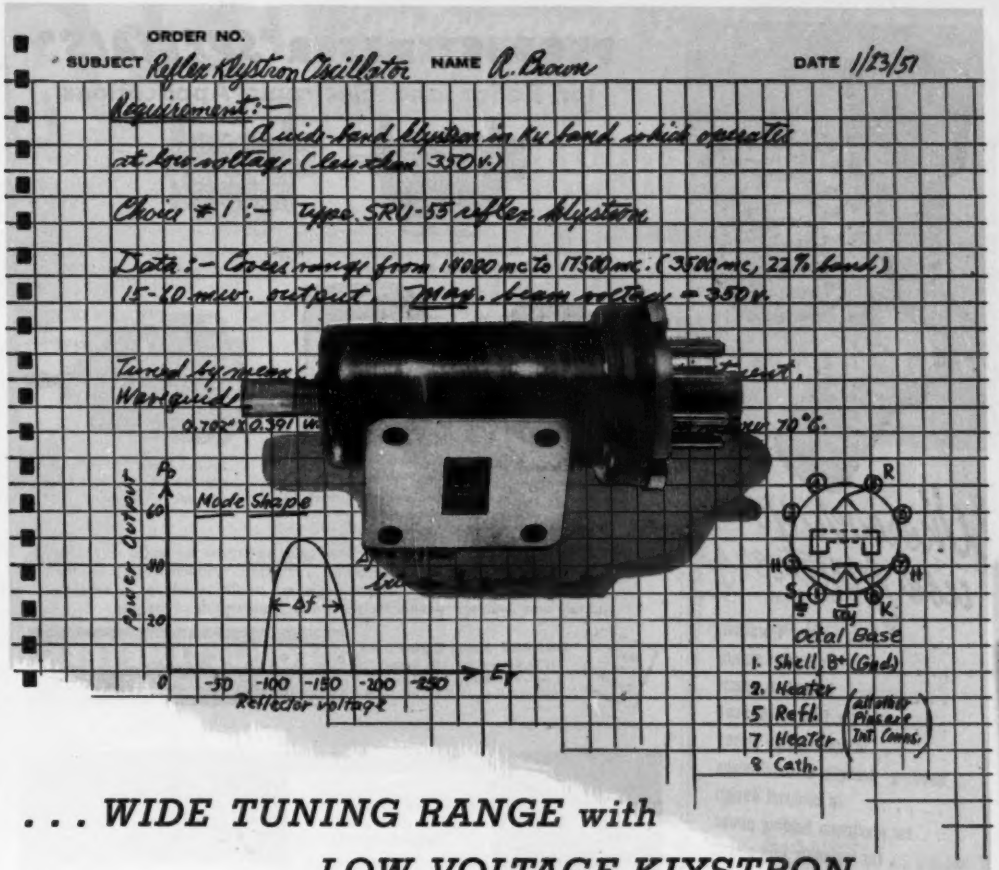
Cabling-Board Pegs

METAL rods are used in place of nails for positioning wires on cabling boards, to improve accuracy and quality in the military radio section of Federal Telephone and Radio Corporation's Clifton, N. J. plant.

Three different techniques are used for anchoring the ends of wires. The most used and most

Use of metal wire-positioning rods and steel clips on cabling board

Pushing wire into slot of wood dowel rod



. . . WIDE TUNING RANGE with LOW-VOLTAGE KLYSTRON

14,000 to 17,500 MC at 300 VOLTS

Type SRU-55 is a low-voltage, reflex klystron oscillator with radio frequency output of 15 to 60 milliwatts, operating over the frequency range of 14,000 to 17,500 mc. This Sperry tube can be used as a local oscillator for microwave receivers or as a bench oscillator in the measurements laboratory.

Operating at a frequency of 16,000 mc with a beam voltage of 300 volts, this tube provides 25 milliwatts of output power. Under these conditions the modulation sensitivity is approximately 1.3 megacycles per volt. The electronic tuning range measured between 3 db points is 75 megacycles per second.

Physical characteristics of Sperry Type SRU-55 are: weight, 3¼ oz. — height, 3 1/16" — mounting, standard octal 8-pin socket (in any position). The r-f connection is a standard UG-419/U fitting for 0.702" x 0.391" waveguide. Its cathode is of the oxide coated, unipotential type. For ambient temperatures below 70°C, only free convection cooling is required. The tuning adjustment on this tube is driven by a ¼" shaft containing a screwdriver slot.

For additional information on Type SRU-55 and other Sperry Klystrons, write our Special Electronics Department.

MODEL SRU-55	
GENERAL CHARACTERISTICS	
Freq. Range (mech. tuning)	*14,000-17,500 mc.*
Heater Voltage (ac or dc)	*6.3 v.*
Heater Current	*0.6 amp.*
MAXIMUM RATINGS	
Beam Voltage	*350 v.*
Beam Current	*35 ma.*
Reflector Voltage	*0 to —350 v.*
Heater-Cathode Voltage (peak)	*45 v.*

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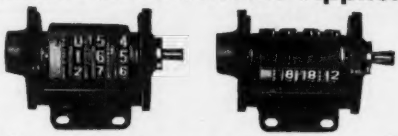
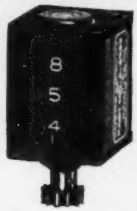


Companion shutter counters used as dual direction indicators. One counter adds while the other subtracts. Shutter blanks out counter which is an negative side of 000.

"Y" 2-figure Rotary Counter used in navigating instruments.



High-speed, non-reset "Y" type counter for building into radar instruments.

Special Model "Y" with window at rear designed for use in radar equipment.

These are a few of the "specials" developed by Durant for Radar and Electronic applications. When one of the many standard Productimeters is not the exact answer to a problem, Durant engineers modify, combine, or develop entirely new counters to meet the particular requirements of the job.

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SPECIFICATIONS

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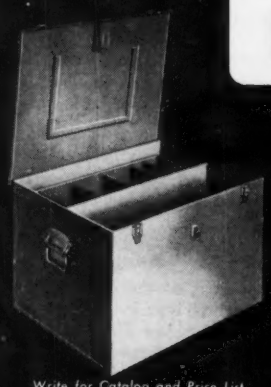

Manufactured to meet material, workmanship and finish requirements of Army-Navy specifications.

Accessories: Internal framing, partitions, trays and wood chucks as required.

Complete Facilities under one roof for quality mass production, including: Heliarc welding, baking and finishing. Whistler and Wiedermann equipment for short runs. Tool and die engineering and designing. Completely conveyerized finishing facilities. Large assortment of stock and special dies for radio and television and electronic field.

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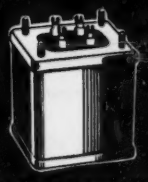

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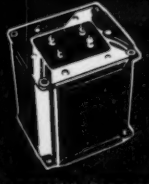


Commercial Components

FREED 1020-B MEGOHMMETER

A precision electronic megohmmeter which for years has given satisfactory service in hundreds of laboratories and on production lines.

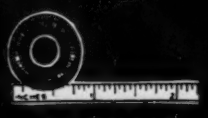
- **EASY TO READ**
  Direct reading on a 4" scale.
  Protected against overload.
- **RAPID & SAFE TO USE**
  Test voltage removed from terminals and capacitive components discharged to ground in all positions of multiplier switch.
- **ACCURATE**
  Within 3% up to 100,000 megohms, 5% from 100,000 to 2,000,000 megohms.

SPECIFICATIONS

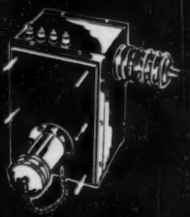
Range: 1 megohm to 2,000,000 megohms in six overlapping ranges selected by a multiplier switch.
Voltages on Unknown: The voltage applied to the unknown terminals is 500 volts d-c and is independent (less than 1%) of the value of the unknown.
Stability: Line voltage variations from 105-125 volts will cause less than 2% variation in the meter reading.
Power Supply: 105-125 volts A.C. 50-60 cycles 30 watts.
Dimensions: 9½ x 10½ x 8 inches.
Net Weight: 18 pounds.

Sub-miniature hermetically sealed Toroidal Inductors

Freedseal Treatment ANE-19 Specs



Miniature Inductors



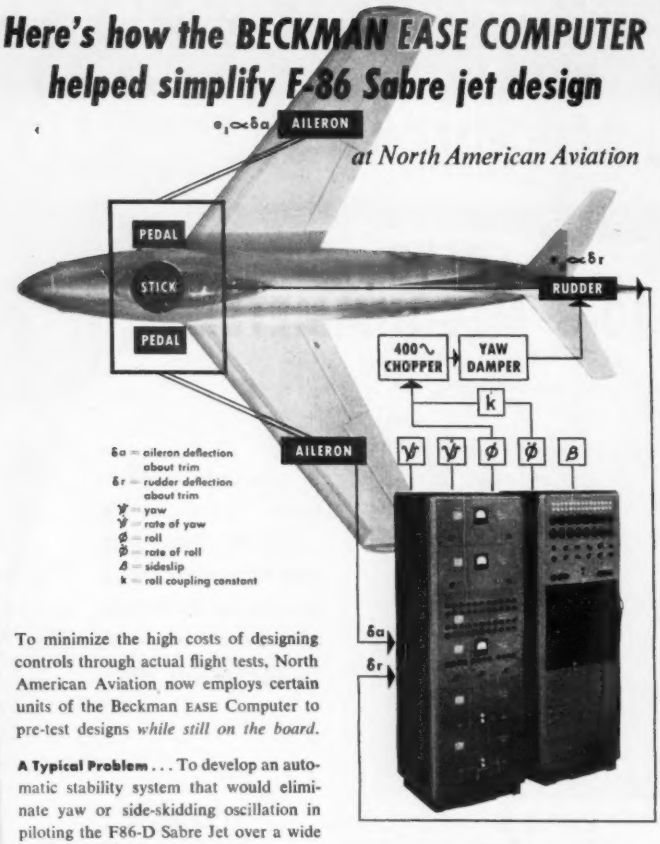
Pulse Modulators

FREED TRANSFORMER CO., INC.

1722B WEIRFIELD ST. RIDGEWOOD, BROOKLYN 27, N. Y.

Here's how the BECKMAN EASE COMPUTER helped simplify F-86 Sabre jet design

at North American Aviation



To minimize the high costs of designing controls through actual flight tests, North American Aviation now employs certain units of the Beckman EASE Computer to pre-test designs *while still on the board.*

A Typical Problem . . . To develop an automatic stability system that would eliminate yaw or side-skidding oscillation in piloting the F86-D Sabre Jet over a wide range of speeds and at altitudes from sea level to the stratosphere.

How North American Solved It . . . The diagram above shows how North American used certain units of the Beckman EASE Computer to quickly solve the problem by flight simulation. A control-system mockup was designed by engineers at North American which generated voltages proportional to aileron and rudder deflections made by movement of mockup stick and pedals. These voltages were fed into the computer so that its electrical response was analogous to the response of the F86-D in flight. Flight conditions—speed and altitude—were varied on the computer by merely turning knobs.

Airborne performance confirmed the results as developed by flight simulation!

WHAT ABOUT YOUR DESIGN PROBLEMS?

The Beckman EASE Computer is currently being used to solve design problems on such products as guided missiles, submarines, railroad cars, automobiles, military vehicles—and has many other time and money-saving applications in industry and research. It is not only, by far, the lowest priced quality instrument in the field . . . but its unitized design, employing compact rack-mounted components, permits the user to select a custom computer which meets his exact requirements—whether as equation solver, simulator, or tester. Let us study your design problems and make helpful suggestions on applying the EASE to your operations!

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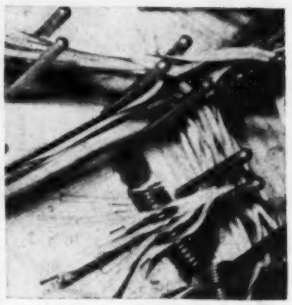


Use of springs to anchor ends of wires

satisfactory is a spring steel clip that is pushed into holes drilled in the board to make a force fit. Each clip holds a single wire in practice, even though it could grip two or more. Individual clips permit checking for completeness of the harness at a glance by noting whether all clips are filled.

During a shortage of the steel clips, substitutes made from hardwood dowel rods were used instead. The rods were driven into slightly undersize holes in the board after slotting one end of each rod. Slot width was slightly less than insulation thickness, to give a gripping action.

Where a large number of wires terminated in a small area on the board, a coil spring was fastened to the board with two wood screws and wires were pushed between adjacent turns of the spring. Here one turn of spring was used for each wire, hence the entire spring had to be filled to complete the harness.

When a particular cabling board is no longer needed, pegs and clips are pulled out for reuse on new boards.

Drafting Board is Low-Cost Wiring Bench

ADJUSTABLE-HEIGHT, adjustable-angle drafting boards costing approximately fifteen dollars each provide an ideal working position for wiring and assembly of magnetic drum storage unit panels used in IBM electronic data processing machines. A simple angle-iron framework added to the rear of the bench near the floor provides sup-

These "Firsts" Helped Westinghouse Customers

USERS OF WESTINGHOUSE TUBES GET FIRST BENEFITS FROM MANY NEW TUBE DEVELOPMENTS

These are only a few of the "firsts" that Westinghouse created in the electronic tube industry. In each case, designers using Westinghouse Tubes gained advantages by having first chance to use these innovations.

Today, Westinghouse still pioneers in electronic tubes and tube making. For instance, Westinghouse 40 KV and 20 KV rectifying tubes are under 9 ounces, only 2¾" high. Designers seeking the ultimate in space and weight savings will find them in these new WL-6102 and WL-6103 tubes.

Radical new developments in other power tubes and receiving and television picture tubes are now being engineered at the *NEW* Westinghouse Electronic Tube Division at Elmira and Bath, New York.

NEW SERVICE, NEW DISTRIBUTION

Westinghouse plans for Electronic Tube Division expansion are in operation. New service facilities, new warehousing policies, and new distributors are opening rapidly.

New merchandising methods will aid distributors in serving industrial users—many of these business-building programs are totally new in the tube industry. Here, as elsewhere, Westinghouse plans to provide industry leadership in service.

It pays in profits to deal with Westinghouse and with Westinghouse distributors. For full information on how Westinghouse can help you with problems of design, service, or supply, call your nearest Westinghouse representative, or write to Department A-110.

RELIATRON™ TUBES

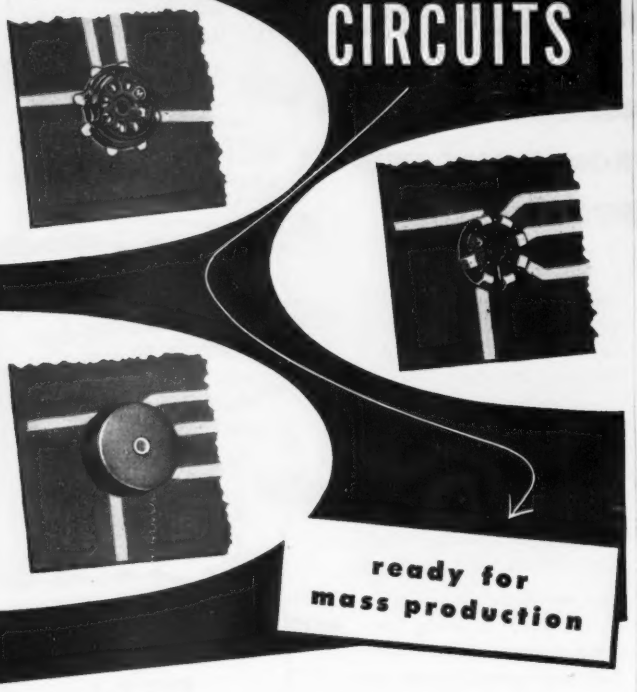
YOU CAN BE SURE...IF IT'S Westinghouse

ET-95003

ELECTRONIC TUBE DIVISION

Westinghouse Electric Corporation
Box 284, Elmira, N. Y.

Tube Sockets for PRINTED CIRCUITS



METHODE, now ready with volume production capacity on seven pin miniature tube sockets for printed circuit application . . . offers units with simple, time-proven design features providing reinforced mechanical spring contact with printed conductors, easily supplemented by solder dip operations. Insulators and retainer caps are heat resistant black phenolic and hardware is cadmium plated copper base alloy.

Recommended Usage: 1) sockets are snapped into keyed holes of $^{43}/_{64}$" diameter; 2) insulating panel is solder dipped on under side to fuse socket terminals to printed conductors; 3) supplementary connections for top panel connections, if necessary, are spot soldered; 4) retainer cap is eyeletted or screwed to socket, locking assembly to board and assuring pressure contact.

We invite your inquiries

METHODE Manufacturing Corp.
2021 West Churchill Street
Chicago 47, Illinois

Geared to produce
Plastic and Metal Electronic Components

smaller than a suitcase

AMERICAN ELECTRIC
400 Cycle
MOTOR
ALTERNATOR

WEIGHT: Approx 125 lbs.
SIZE: 22" x 12" x 12"

Designed for production and laboratory high frequency power supply requirements. STRONG—SIMPLE—INDESTRUCTIBLE CONSTRUCTION—No delicate moving parts, brushes or springs to wear out or maintain.

Replaces single large, hard-to-get H-F power supply serving multiple purposes . . . *A bank of these compact, flexible units costs far less, provides individual portable power sources for each project, avoids downtime hazards of single unit!*

Meets power supply requirements for AN-E-19 equipment.

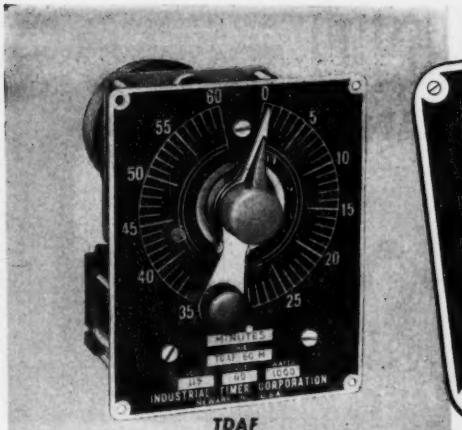
OUTPUT: Up to 1000 Watts single phase 115V or up to 1800 Watts three phase 115/200V. Input: 60 cycle AC.

Total harmonic content under 5%; ± 1% voltage regulation.

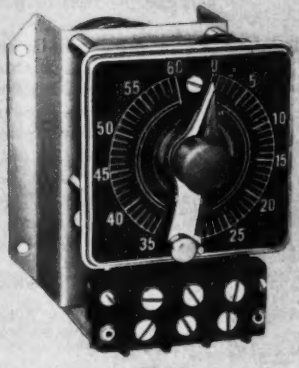
WRITE FOR DETAILS!

Larger capacities available.

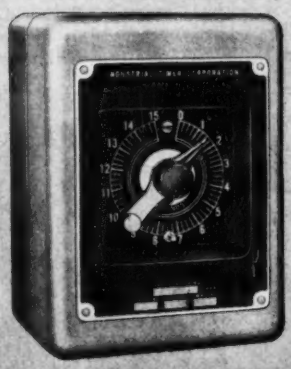
AMERICAN ELECTRIC MOTORS



TDAF



TDAB



TDAB (in case)

TWO IMPROVED TYPES of Synchronous Motor Driven TIME DELAY TIMERS for Industrial Applications

Time Delay Timers are designed for application on circuit controls where a time delay is required between the closing of one circuit and the predetermined closing or opening of another.

Series TDAF and Series TDAB Time Delay Timers are built to stand abuse, and afford the dependable, consistent operation which modern industrial applications demand.

These timers are designed to handle time cycles up to 3 hours. They employ an external, magnetically-operated clutch that not only assures exceptional accuracy but permits *instantaneous*, automatic reset. Thus these timers are ideal for use where rapid recycling is necessary.

OUTSTANDING FEATURES

Automatic, Instant Reset—As soon as the clutch is disengaged, an internal spring brings the actuating arm back to its reset position in a fraction of a second.

Time Setting Adjustment—Adjustment is accomplished by simply moving the black-button pointer to the time cycle required. Quick, easy, accurate.

Dial—Dials of both series have large, easily read numerals.

SERIES TDAF TIMERS

for panel mounting. Terminal strip for electrical connections located at back. 115 volt and 220 volt, A.C.—25, 50, and 60 cycles. (For time ranges, see chart.)

SERIES TDAB TIMERS

for surface mounting. Terminal strip for electrical connections located at front, below dial. If required, can be supplied in steel housing, as illustrated—eight knockouts for easy hook-up. 115 volt and 220 volt, A.C.—25, 50 and 60 cycles. (For time ranges, see chart.)

TIME RANGES—Series TDAF and Series TDAB Timers

DIAL CALIBRATION	MAXIMUM TIME CYCLE
1/10 Second	5 Seconds
1/4 Second	15 Seconds
1/2 Second	30 Seconds
1 Second	60 Seconds
2 Seconds	3 Minutes
5 Seconds	5 Minutes
15 Seconds	15 Minutes
30 Seconds	30 Minutes
60 Seconds	60 Minutes
2 Minutes	3 Hours

For complete technical data request bulletin 39

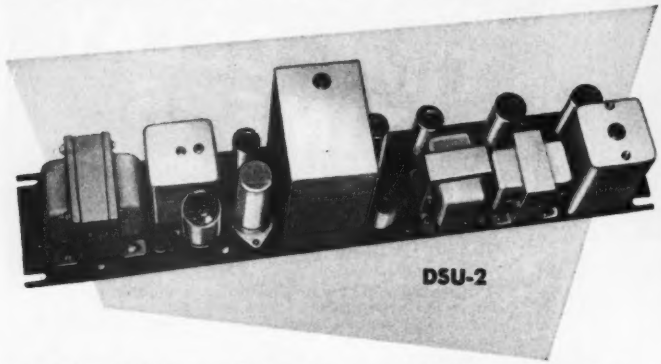
MANUFACTURERS OF THESE AND OTHER TIMERS AND CONTROLS FOR INDUSTRY—Cam Timers • Manual Set Timers • Tandem Automatic Recycling Timers • Instantaneous Reset Timers • Running Time Meters

Timers that Control the Pulse Beat of Industry

INDUSTRIAL TIMER CORPORATION

115 EDISON PLACE, NEWARK 5, N. J.

HAMMARLUND
DUPLEX SIGNALING UNIT



- **Watchdog of Indispensable Circuits**
- **Controller of Remote Operations**

The Hammarlund Standard Duplex Signaling Unit consists of a tone generator and frequency selective receiver designed to operate over wire lines, telephone or power line carrier, and radio or microwave communications circuits for signaling, dialing, slow speed telemetering, supervisory controls or other information. Transmitters and receivers are available for 33 frequency channels between 2000 and 6025 cps.

This equipment is ideally suited to requirements of emergency services, broadcasters, military and governmental agencies, pipeline and power companies, airlines, railroads and other groups requiring remote on-off switching, continuous indication of operating conditions, and automatic detection of wire line or power source failures along their systems.

Make Hammarlund Duplex Signaling Units your electronic watchdogs and supervisors.

Write Today For Detailed Information

HAMMARLUND
MORE THAN 40 YEARS EXPERIENCE COUNTS!
THE HAMMARLUND MANUFACTURING CO., INC.
460 WEST 34th STREET • NEW YORK 1, N.Y.

Use of inexpensive drafting table for assembly work

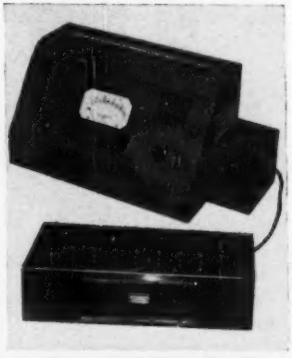
port for the reels of wire used in the operation.

To hold the work in position on a slanting board, four studs are set into the board and the panel is fastened to them with thumb screws. These boards proved much cheaper and yet more satisfactory than conventional benches in the Poughkeepsie, N. Y. plant of International Business Machines Corp.

Capacitor Breakdown Tester

By Curtiss R. Schafer
The Liquidometer Corp.
Long Island City, N. Y.

In the capacitor breakdown test unit shown, a d-c voltage, usually equal to twice the rated voltage of the capacitor, is applied for one minute. The on time is controlled



Capacitor tester: hinged box for ten capacitor units, in foreground, is connected to cut off high voltage automatically when cover is raised, to protect operator

Lapp

PLUG-AND-RECEPTACLE for Sectionalizing Circuits

SIMULTANEOUS contact of any number of leads can be made or broken by use of Lapp Plug-and-Receptacle units, for panel-rack assembly or other sectionalized circuits. Insulation is Steatite, the low-loss ceramic which is non-carbonizing, even when humidity, moisture or contamination sets up a leakage path. The unit shown above provides twelve contacts, rated for operation at 2.5Kv peak terminal-to-terminal, 1.5Kv peak terminal-to-ground, 25 amps at 60 cps. All contacts are silver-plated; terminals are tinned for soldering. Polarizing guide pins assure positive alignment. Write for specifications of this and other available units, or engineering recommendations for special units for your product.

Lapp Insulator Company, Inc., LeRoy, New York

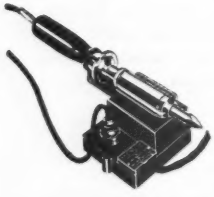
Lapp

American Beauty

Electric Soldering Irons are Service Proven...

Since 1894

These features make American Beauty the Standard-of-Perfection on the world's production lines . . . where dependability, long life and efficiency are demanded.



TEMPERATURE REGULATING STAND

Thermostatically controlled to maintain heat of iron at any desired temperature while at rest.

- Nickel-coated, corrosion-resistant tips, easily and quickly replaced
- Super-flexible cord, American Beauty made, resists wear due to flexing
- Heating element of chrome-nickel ribbon resistance wire
- Insulated with pure mica
- Built-in adapter for ground wire

WRITE FOR FREE LITERATURE

A-102

AMERICAN ELECTRICAL HEATER COMPANY
DETROIT 2, MICHIGAN

DOUBLE BARREL
Advertising

Advertising men agree—to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige.

Direct Mail supplements your Display Advertising. It pin-points your message right to the executive you want to reach—the person who buys or influences the purchases.

More and more companies are constantly increasing their use of Direct Mail because it does a job that no other form of advertising will do.

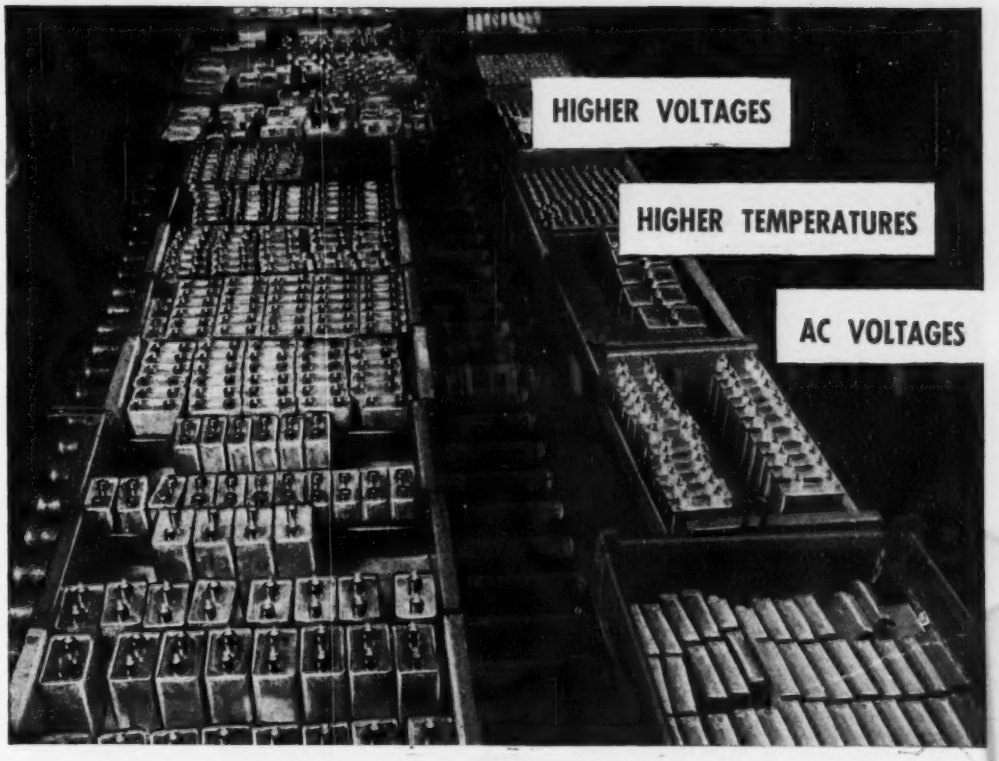
McGraw-Hill has a special Direct Mail Service that permits the use of McGraw-Hill lists for mailings. Our names give complete coverage in all the industries served by McGraw-Hill publications—gives your message the undivided personal attention of the top-notch executives in the industrial firms. They put you in direct touch with the men who make policy decisions..

In view of present day difficulties in maintaining your own mailing lists, our efficient personalized service is particularly important in securing the comprehensive market coverage you need and want.

Ask for more detailed information today. You'll be surprised at the low over-all cost and the tested effectiveness of these hand-picked selections.

Dept. A

McGRAW-HILL
PUBLISHING CO., INC.
330 West 42nd Street
NEW YORK 18, N. Y.



General Electric can show you how to make wider use of JAN-C-25 capacitors

From years of experience in manufacturing paper-dielectric capacitors, General Electric can show you how to make wider use of your JAN capacitors.

These capacitors are used in thousands of applications — primarily d-c at rated voltages and temperatures. However, most JAN units can be operated at other voltages and under widely varying conditions.

For example, actual life tests have shown that a General Electric 1 muf. CP 70 unit rated for a minimum life of 10,000 hours at 1000 v. d-c and 40 C or 700 v. d-c and 85 C, can also be used at:

Higher voltages—1380 v. d-c at 85 C for 500 hours.
1300 v. d-c at 85 C for 1000 hours.

Higher temperatures—105 at 525 v. d-c for 500 hours.

AC voltages—440 volts, 60 or 400 cycles with normal JAN-C-25 derating.

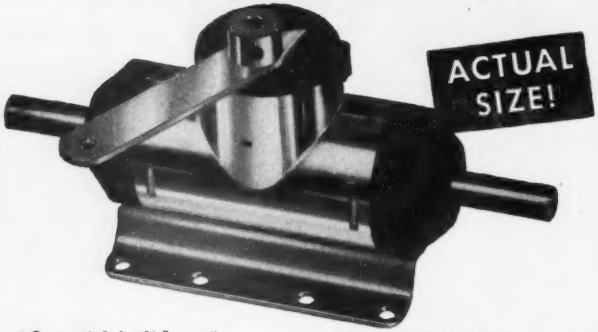
General Electric has similar data for most of its JAN units, showing how each may be operated under a variety of conditions. For information on how these standard G-E capacitors may be applied in your circuits, consult your Apparatus Sales Office, or write to Specialty Capacitor Sales, General Electric Company, Hudson Falls, N. Y.

GENERAL ELECTRIC

407-507

Metron MINIATURE SPEED CHANGERS

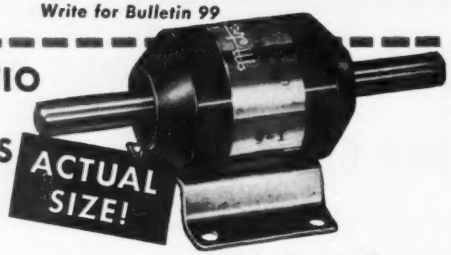
VARIABLE SPEED DRIVES



- Compact! Only 4¾" overall
- Light! Weigh only 5½ oz.
- Continuously variable speeds over a wide range
- Knob, lever, push-rod or gear control (Lever control illustrated)
- Rotation in either direction
- Coaxial shafts for in-line construction
- Ball-bearings throughout
- Completely sealed
- Permanently lubricated for trouble-free high/low temperature service
- Operate in any position

Write for Bulletin 99

FIXED RATIO SPEED CHANGERS (Gear Type)



- Only 1.050" diameter!
- Single section weighs only 3 oz.
- STANDARD ratios from 10:9 to 531,441:11
- Hobbed gears for smooth, precision running
- Anti-backlash units . . . virtually zero backlash in either direction
- Completely sealed
- Permanently lubricated
- Mount in any position

Write for Bulletin 100

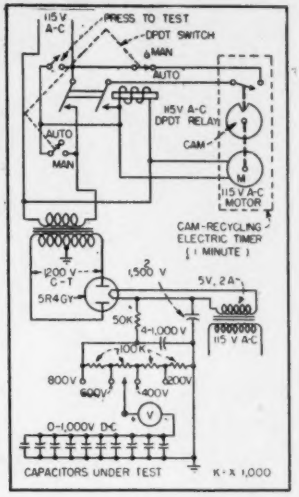
MINIATURE COMBINATION FIXED AND VARIABLE SPEED CHANGERS

For applications requiring variable speed at a reduced nominal output speed, combinations of Metron Variable Speed Drives and Fixed Ratio Speed Changers are available in compact, integral units. Ask for Technical Data, or write giving your requirements for prompt engineering recommendations and prices.

METRON INSTRUMENT COMPANY

440 Lincoln Street • Denver 9, Colorado

BUILT BY Metron MAKERS OF INSTRUMENTS FOR PRECISION MEASUREMENT



Circuit gives choice of automatic 1-minute high-voltage test or manually timed application of high voltage to capacitors

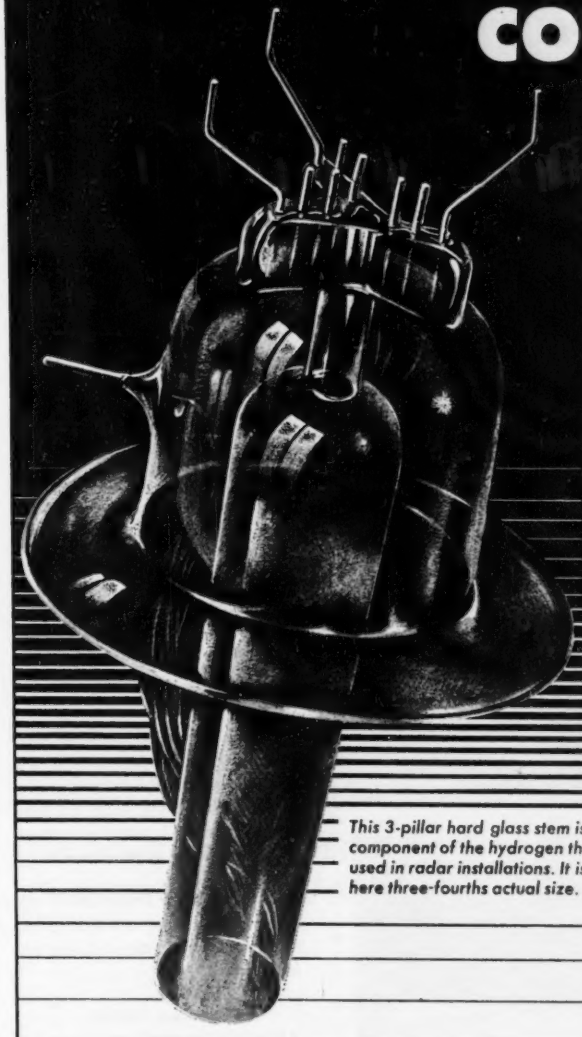
by a built-in timer of the synchronous motor type.

Ten capacitors are tested at a time. The capacitor tray has a hinged cover; when this cover is raised, the high voltage is automatically cut off, to preclude the possibility of shock to the operator. A shorted capacitor causes the meter to indicate the total applied voltage; a capacitor with excessive leakage causes a partial deflection of the pointer. A good capacitor causes only a momentary deflection, depending upon the capacitance value, after which the pointer returns to zero. A meter having a resistance of 5,000 ohms per volt is used. The applied voltage is selected by a switch. If the timer is not wanted, it is switched out and application of the test voltage is controlled by a press-to-test pushbutton switch.

If a shorted or leaky capacitor is indicated in the group under test, the operator must open the tray and remove capacitors one at a time until the faulty unit is eliminated.

In addition to the breakdown test, each capacitor is checked for actual capacitance value and dissipation factor on a General Radio 740-B bridge. A small percentage from each shipment is checked by the

when *production* COUNTS!

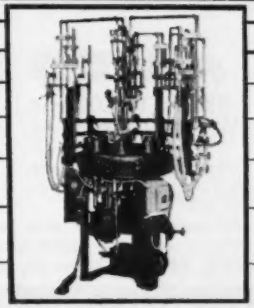


MACHINE-PRODUCED 3-PILLAR HARD GLASS STEMS . . . ANOTHER KAHLE SOLUTION TO DIFFICULT PROBLEMS OF ELECTRONIC TUBE PRODUCTION.

Hand-blown hard glass stems proved too costly for a recent Kahle client. The problem was to find a machine capable of mass-producing uniform 3-pillar hard glass stems. Kahle's solution was to design and build the special purpose machine, Model 1958, shown below. This unique, hydrogen-fired machine permits semi-skilled operators to produce the hard glass stems in quantity . . . maintaining rigid quality control.

This is but one of hundreds of problems solved by Kahle. In every case, Kahle's experience and ability have resulted in the design, development and production of a machine engineered to produce results as specified. Working closely with your organization, Kahle's experienced staff of electronic and equipment engineers will, at your request, recommend a solution to your own specialized production problems. Learn how Kahle's more than 40 years of practical experience can benefit you . . . write Kahle now.

This 3-pillar hard glass stem is a vital component of the hydrogen thyratron used in radar installations. It is shown here three-fourths actual size.



Kahle ENGINEERING COMPANY

1310 SEVENTH STREET NORTH BERGEN N. J.

STANDARD
Radio Interference and Field Intensity
MEASURING EQUIPMENT

Complete Frequency Coverage -- 14kc to 1000mc!

NM - 10A *VLF*

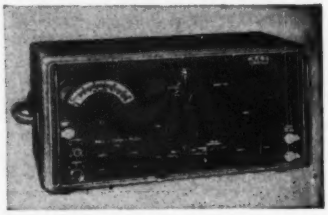
14kc to 250kc
Commercial Equivalent of AN/URM-6.
Very low frequencies.

HF **NM - 20A**

150kc to 25mc
Commercial Equivalent of AN/PRM-1. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies.

NMA - 5A *VHF*

15mc to 400mc
Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.



UHF **NM - 50A**

375mc to 1000mc
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as JAN-I-225a, ASA C63.2, 16E4(SHIPS), AN-I-24a, AN-I-42, AN-I-27a MIL-I-6722 and others.

STODDART AIRCRAFT RADIO CO.
6644 SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA
Hillside 9294

Now BERYLLIUM COPPER STRIP

...rolled to *precision tolerances* and to *ultra-thin gauges*

WE CAN MEET your requirements for one pound—or for thousands. We can meet them in a hurry, too—because we keep a working inventory of beryllium copper that insures delivery within two to four weeks.

WE REGULARLY custom-roll beryllium strip up to 6" wide and down to .0005" thin—to tolerances as close as ±.0001"—solution annealed or rolled to temper.

WE'RE SPECIALISTS in cold-rolling a wide variety of metals—to your specifications... in any quantity. It's everyday work for us to roll strip to exacting specifications—the "tough ones" that commercial mills ordinarily refuse to produce.

We also custom-roll Invar • Phosphor Bronze • Copper • Brass • Nickel-Silver • Stainless Steels • Nickel • Monel • Haynes Stellite Alloys • Magnetic Alloys • Chrome Iron Alloys . . . and many others.

WE CARRY a working inventory of some metals... and also re-roll **your** metals on a toll basis. Our up-to-the-minute equipment includes precision 2-High, 4-High, and Sendzimir rolling mills . . . precision gang slitters ... and continuous atmosphere annealers.

OUR ENGINEERING DEPARTMENT will be happy to assist you with your custom-rolling problems. Just write or call—and ask for our catalog.

INDUSTRIAL DIVISION
AMERICAN SILVER COMPANY, Inc.
36-03 PRINCE STREET, FLUSHING 54, N. Y.

ASC — APPLYING SCIENCE TO CRAFTSMANSHIP

"We would pay a premium for these 50,000 Air Shipments yet we actually saved thousands of dollars!"

Robert S. Woolf, Mgr., Teletranscription Dept., Dumont Television Network

"When we ship TV film, we're interested in *service*. We can't afford to take any other attitude. We've bought program time all over the country, and those programs *must* be filled.

"We at Dumont use Air Express. It's the fastest. It has all-point coverage. Above all, it is DEPENDABLE.

"As to cost – Air Express costs Dumont *less* than other air services would, by thousands of dollars per year! For instance, on our regular shipments to Detroit, other services cost 37% to 337% *more* than Air Express. And we can't duplicate the service at any price!

"The Air Express people have carried upwards of 50,000 shipments for Dumont in the last four years. Their ability to trace shipments – especially when being shuttled between stations – is almost uncanny! It has helped us out in many an emergency.

"It pays to specify Air Express – in more ways than one!"

AIR EXPRESS

GETS THERE FIRST

Division of Railway Express Agency
1952 – our 25th year of service

KLEINS

the widest selection of quality pliers

FOR EVERY WIRING NEED...

● Why put up with pliers that aren't *exactly* right—pliers that may be costing you valuable production minutes? In the complete Klein line there is a pair of pliers for *every* job in radio, TV or amplifier wiring. You'll find long nose pliers that assure a tight grip even in confined space, keen edged cutters, flat nose, duck bill—whatever you need, and in a wide variety of sizes.

Klein Pliers are better pliers, too, each pair individually tested for proper balance and hand-fit. Made by plier specialists with a reputation for quality "Since 1857."

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

This Klein Pocket Tool Guide gives full information on all types and sizes of Klein Pliers. A copy will be sent without obligation.

"Since 1857"

Mathias KLEIN & Sons

Established 1857 — Chicago, Ill., U.S.A.

1200 BELMONT AVENUE CHICAGO 18 ILLINOIS

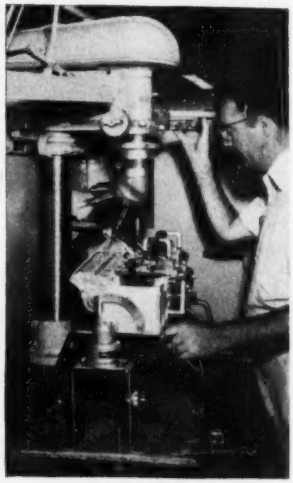
engineering department for hermetic sealing, and for variations in capacitance and dissipation factor over the temperature range from −65 C to +125 C.

These test units have been designed, for the most part, to check components for a production line producing between 200 and 5,000 electronic fuel gage amplifier or indicator units per month. These quantities would not be considered high in the radio or television receiver industry, but they are relatively high for the production of precision aircraft fuel gauges at this time.

The author acknowledges the skillful work of Arthur Hull in the mechanical layout of these units and their actual construction and wiring.

Chassis-Tilting Cradle

A SINGLE cradle serves for assembly, machining and testing operations on the base unit for an electronically controlled IBM key punch. A Powrarm Junior holding fixture is mounted on a sheet metal pedestal at one end of the plywood pallet, and a plain pivot support for the chassis is bolted to the other end. For drilling operations, a guide fixture is clamped over the chassis and a welded steel frame work is slipped under it to take



Use of multiple-spindle drill press on chassis while mounted in special cradle

Announcing

A COMPLETE LINE OF

Plastic Film Dielectric

CAPACITORS

Plastic Capacitors, Inc., offers you a complete line of plastic film capacitors in a wide range of electrical characteristics, values, impregnant and containers. Because the solid film is chemically stable, has great dielectric strength and is non-porous, these capacitors are smaller in size and lighter in weight than capacitors of equivalent values using conventional dielectrics. By making a proper choice of the solid dielectric film and impregnant, the important electrical characteristics are accentuated, thereby increasing the effectiveness of the circuit in which the capacitors are used. Containers include glass tubular, bathtub, drawn and fabricated rectangular, and drawn oval—all hermetically sealed.

THESE CAPACITORS OFFER YOU

- √ Operation up to 150° C and more without voltage derating.
- √ Series resistance exceeding 10^{12} megohms/mfd and as high as 10^{14} for small values of capacitance.
- √ Dielectric absorption as low as 0.02%.
- √ Power factor at 60 cycles as low as 0.01%.
- √ Q values exceeding 500 at 100 KC.
- √ Capacitance stability to within 0.5% for a period of one year.
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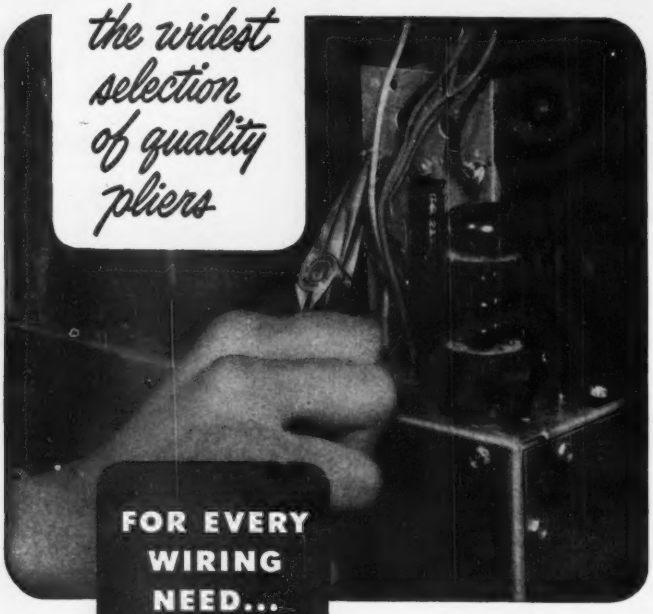

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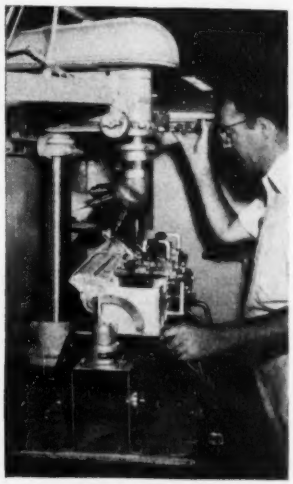
These test units have been designed, for the most part, to check components for a production line producing between 200 and 5,000 electronic fuel gage amplifier or indicator units per month. These quantities would not be considered high in the radio or television receiver industry, but they are relatively high for the production of precision aircraft fuel gauges at this time.

The author acknowledges the skillful work of Arthur Hull in the mechanical layout of these units and their actual construction and wiring.

Chassis-Tilting Cradle

A SINGLE cradle serves for assembly, machining and testing operations on the base unit for an electronically controlled IBM key punch. A Powrarm Junior holding fixture is mounted on a sheet metal pedestal at one end of the plywood pallet, and a plain pivot support for the chassis is bolted to the other end. For drilling operations, a guide fixture is clamped over the chassis and a welded steel frame work is slipped under it to take



Use of multiple-spindle drill press on chassis while mounted in special cradle

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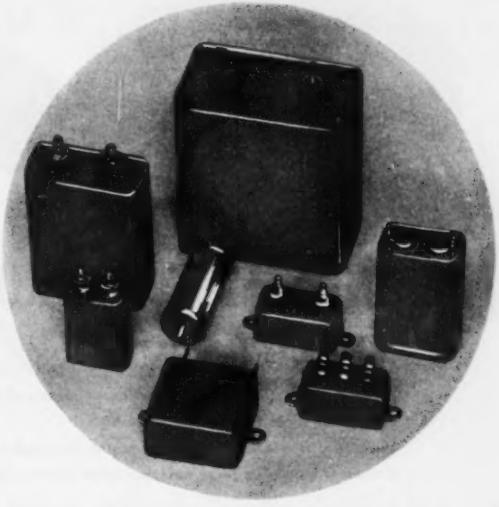

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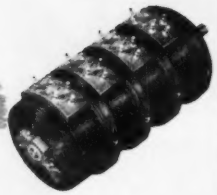

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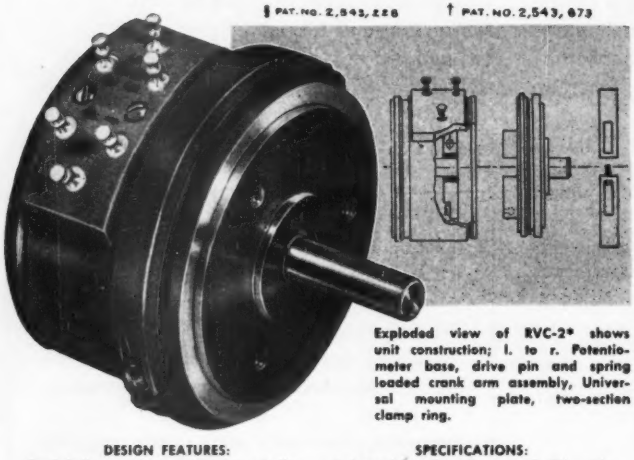

Exploded view of RVC-2* shows unit construction; l. to r. Potentiometer base, drive pin and spring loaded crank arm assembly, Universal mounting plate, two-section clamp ring.

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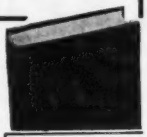

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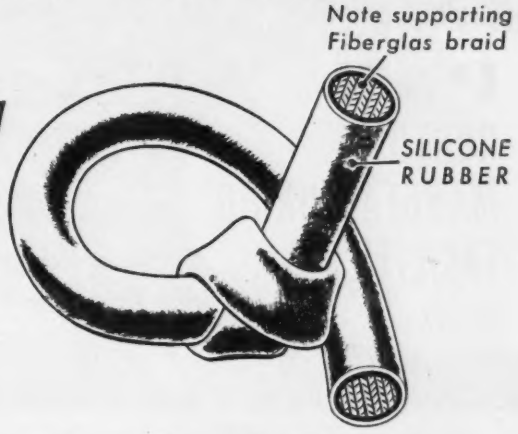

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drilling pressure off the cradle.

For testing, power is applied to a plug mounted on the pedestal. Leads from the plug are connected to the a-c input terminals on the chassis throughout the sequence of test operations in the Poughkeepsie, N. Y. plant of International Business Machines Corp.

TV Alignment Island

IN THE test and alignment section of Emerson's Jersey City television plant, good sets go to the right and bad ones to the left past openings or islands in a wide metal-covered bench. At each island are test facilities, large mirrors and small stocks of spare parts. Access is

Two-man island for testing and aligning television sets. Section of bench in foreground is hinged to provide access

provided by a hinged section of the metal covered bench, the bottom of which often serves for pin-up pictures. A wood fence around the island provides a resting place for the caster-mounted pallets, so that the chassis does not move around during alignment adjustments.

Soldering Plastic Wires to Connectors

TO PREVENT runback of plastic insulation when soldering wires to the terminals of large cable connectors, the terminals are each filled with solder first. Next, the correct stripped wire for a particular terminal is held over the end of the terminal and a soldering iron is applied to the side of the terminal. When the solder inside melts, the stripped end of the wire is quickly inserted without over-heating adja-

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Half Power Angles (H plane)	2.86°	1.92°	1.32°	2.50°	1.74°	1.32°	2.42°	1.61°	1.21°
(E plane)	3.24°	2.04°	1.47°	2.79°	1.94°	1.47°	2.70°	1.81°	1.36°

Input Impedance	52 ohms nominal
VSWR	1.3 to 1 or better
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Polarization	Either vertical or horizontal available at time of installation.
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*Gain and Half Power Angles are dependent on size and frequency of parabolas, — 4, 6, 8 or 10 foot diameter.

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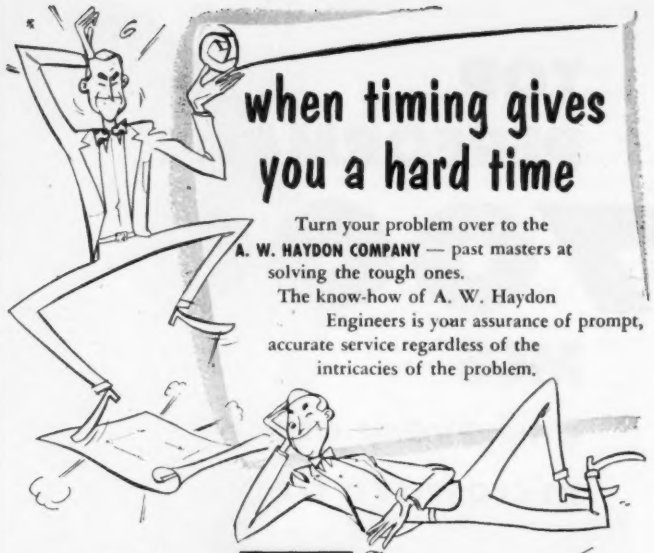

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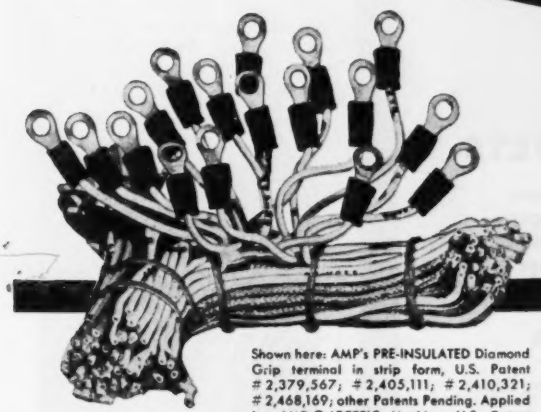

Shown here: AMP's PRE-INSULATED Diamond Grip terminal in strip form, U.S. Patent # 2,379,567; # 2,405,111; # 2,410,321; # 2,468,169; other Patents Pending. Applied by AMP-O-LECTRIC Machine, U.S. Patent # 2,396,913; other Patents Pending.

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Method of soldering wire to cable connector without softening plastic insulation. Wood block serves as fixture for holding connector outside of transmitter housing during assembly

cent plastic insulation. This technique is used in the military radio section of Federal Telephone and Radio Corporation's Clifton, N. J. plant.

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DURING wiring of a 275-socket electronic calculator panel, alligator clips are used freely to hold longer leads in position temporarily. After shorter wires have been put in, the long leads become automatically locked in position and the clips can be removed. This technique has proved highly satisfactory in IBM's Poughkeepsie, N. Y. plant.

Alligator clips hold long leads in position temporarily until enough additional wires have been added to give effect of weaving that locks all wires in position

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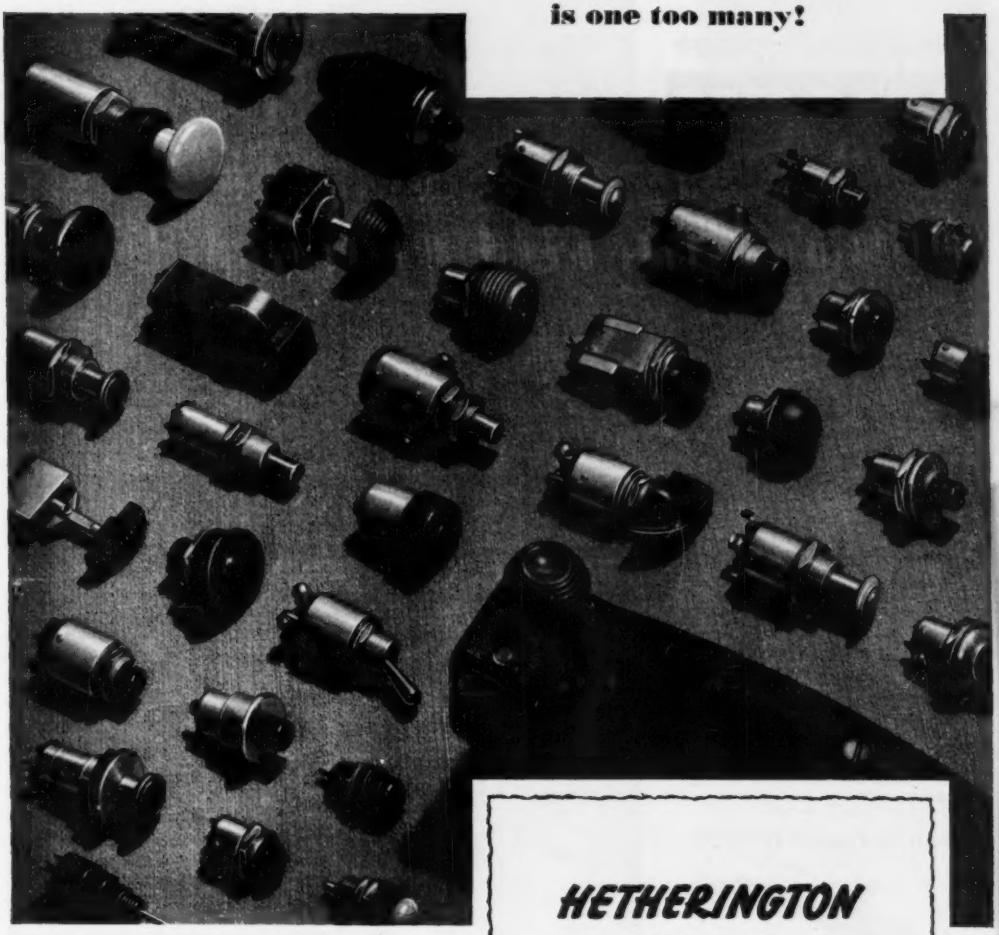

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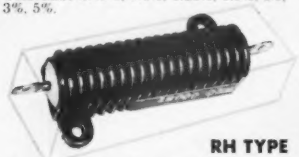

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Available in 2 watt, 5 watt, and 10 watt sizes. Silicone sealed offering maximum resistance to abrasion, high thermal conductivity and high di-electric strength.

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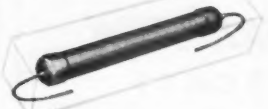

Dalohm precision deposited carbon resistors offer the best in accuracy, stability, dependable performance and economy. Available in ½ watt, 1 watt and 2 watt sizes.

Carefully crafted in every respect, Dalohm resistors are true power in miniature—provide the answer to those space problems.

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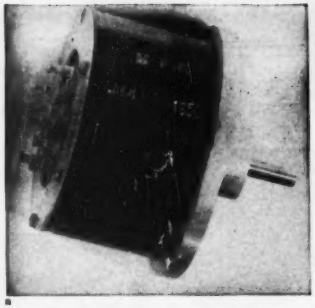
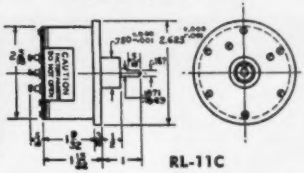


PRECISION POTENTIOMETERS

SINUSOIDAL TYPE



RL-11C

CONDENSED SPECIFICATIONS	RL 11-C	RL 14-MS
Total resistance	16,000 ± 10%	35,400 ± 1%
Percent resistance within brush circle	Approx. 85%	99 ± ¼%
Angle of rotation	360°	360°
Weight	4.75 oz.	1.8 lbs.
Torque (Approximate)	¼ oz. in.	2 oz. in.
Wire	80 Ni 20 Cr	80 Ni 20 Cr
Resolution	.4°	.2°
Angular accuracy	±.6°	±.5°
Amplitude accuracy	±.8%	±.6%
Maximum volts across winding	150	350
Maximum speed	60 rpm	60 rpm
Expected Life	350,000 cycles	200,000 cycles

Illustration shows RL-11C unit, RL-14MS unit is approximately twice as large. Minor variations of these standard designs, available on special order, permit operation at high rotational speeds with some loss of accuracy but, with a substantial increase in expected life. Sine and cosine voltages are produced simultaneously. Resistances other than those shown above are available within certain limits.

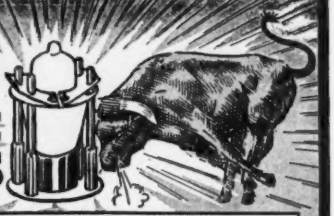
FOR COMPLETE DETAILS SEND FOR BULLETIN F-68-A

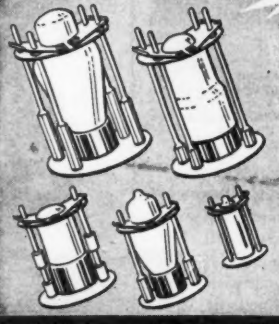
GAMEWELL

THE GAMEWELL COMPANY

NEWTON UPPER FALLS 64, MASSACHUSETTS

SHOCKPROOF VACUUM TUBE RETAINERS





These retainers are used to secure Vacuum Tubes and to resist side motion of Vacuum Tubes used in radio equipment which is subject to shock and vibrations. These retainers meet the requirement of all JAN specifications. The insulated portion is made of a melamine base Fibre Glass Phenol which provides 300 volts insulation to ground and withstands a temperature of 350 F. The insulated plate can readily be fastened or released by hand.

Available for envelope types T7, T8, MT8, T9, T12, ST12, T12ZDL ST14, S14, ST16, T5½, T6½, MT-IC, ST19, T14, ST12SCT-9.

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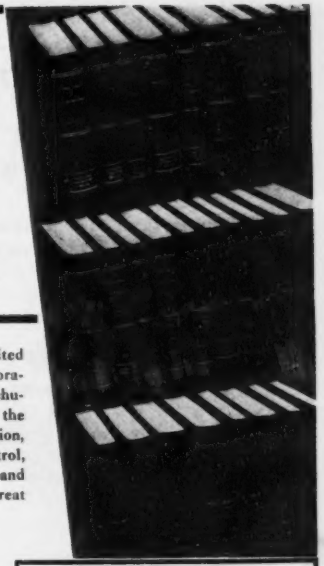

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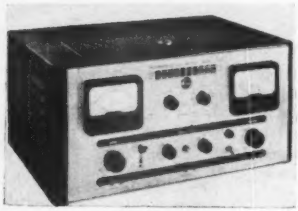
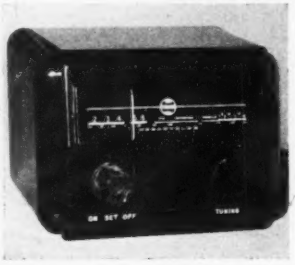


Intermodulation Meter

D&R, LTD., 402 E. Gutierrez St., Santa Barbara, Calif. Model IM-3B intermodulation meter features compactness, simplified operation, high stability and reduced weight. The instrument is provided with high impedance input terminals for bridging at any point within an amplifier. In this manner the contribution of any stage to the total intermodulation factor may be readily determined. A vtvm is provided, having a flat frequency response throughout the range of the instrument, and a sensitivity of 10 mv full scale. The lowest full-scale intermodulation reading is 1.0 percent, and the inherent intermodulation of the instrument is less than 0.1 percent.

Pressure Transmitter

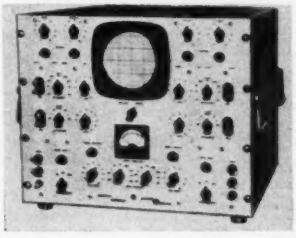
WRIGHT ENGINEERING CO., 180 E. California St., Pasadena 1, Calif. A new pressure transmitter, the Digitran, is available for ranges from 0 to 3 psi absolute to 5,000 psi absolute. It was designed to satisfy the requirements for digital computers, automatic process control and digital recording systems. By using the magnetic field vibrating wire principle, the instrument generates a frequency output variable with pressure, or other physical variables. The use of the stable frequency output can be counted for a specified period of time and a digital number is provided in the electronic counter equal to the pressure experienced. This new technique realizes increased accuracy, resolution, readability and recording without the need for additional conversion equipment to digital numbers.



TV Booster

TURNER CO., Cedar Rapids, Iowa, is producing a new model of its television booster. The model TV-2 employs the cascode circuit, which is noted for its low noise factor, in combination with the Inductuner. The unit tunes continuously over tv channels 2 to 13 with single-knob tuning. A three-way control switch turns on set only, set and booster, or turns off both set and booster simultaneously. The unit is supplied complete with twin-lead lines for quick connection to the receiver.

A simple terminal strip accommodates either 75-ohm coaxial or 300-ohm twin-lead transmission lines.



Dual-Channel Oscilloscope

ELECTRONIC TUBE CORP., 1200 E. Mermaid Lane, Philadelphia 18, Pa., announces model H-21A general- purpose twin-channel oscilloscope that displays two independent signals on the face of a single 5-in. crt. Each of the two channels has individual controls for intensity, focus and positioning of the X and Y axes. Both input signals can be observed either on a common or on separate time bases. Sweep circuits with a range from 2 to 50,000 cps can be triggered externally with a delay of less than 1 sec. Either internal or external sync may be selected. A built-in, direct-reading calibrator supplies a 60-cycle square wave to either vertical amplifier. A panel voltmeter indicates continuous calibration voltage from 0 to 1.5 v peak-to-peak. Range is governed by a built-in attenuator per-

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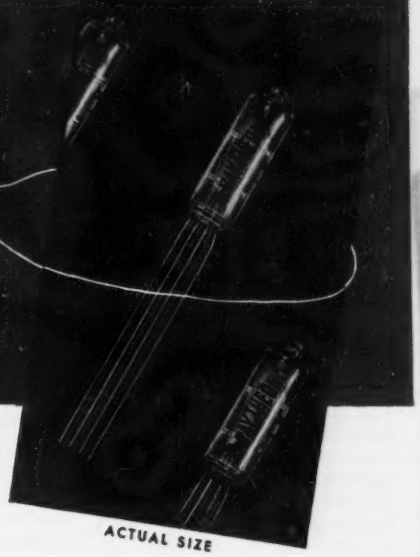

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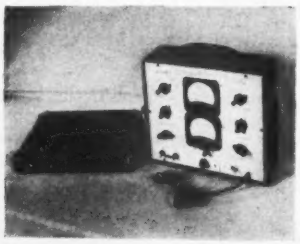
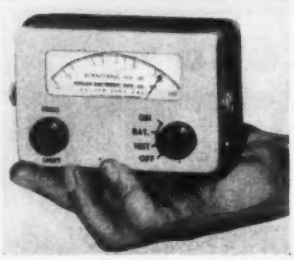
Power Tetrode

RADIO CORP. OF AMERICA, Harrison, N. J. The forced-air-cooled power tetrode type 6166 is designed for vhf service in tv and c-w applications. It has a maximum plate dissipation of 10 kw, is rated for operation up to 220 mc, and utilizes an economical thoriated-tungsten filament. The tube can deliver a synchronizing-level power output of 12 kw in broad-band tv service at 216 mc; and a power output of 9 kw in class C f-m telephony service in circuits operating at 216 mc. The coaxial electrode structure of the 6166 is designed especially for use with high-power circuits of the coaxial-cylinder type. The design provides low-inductance, large-area, r-f electrode terminals for insertion into the cylinders, and facilitates multiple use of the 6166 in cavity circuits.



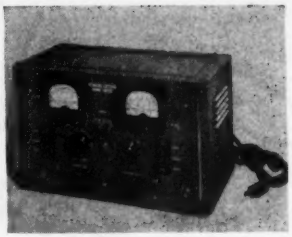
Germanium Diode Checker

GENERAL ELECTRIC CO., Syracuse, N. Y., has announced a germanium diode checker for use in laboratories, quality control groups, service shops and wherever a need exists for checking static characteristics of diodes. Among the device's other uses are general resistance checking, an accurately metered power supply, and forming electrolytic capacitors and checking d-c leakage current. The type ST-12-A has test clips for diodes having leads, and for those with pins on each end. Diode resistance is checked by placing a variable accurately-metered d-c voltage across the diode. A three-inch voltmeter and three-inch current meter permit voltage and current to be metered simultaneously. A chart of manufacturer's limits for about 40 of the most commonly used diodes is secured in the cover of the new unit.



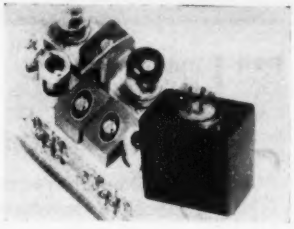
Radiation Detector

JORDAN ELECTRONIC MFG. CO., INC., 9042 Culver Blvd., Culver City, Calif. The Radector, a radiological monitoring field unit for civil defense, military or industrial use, utilizes the Neher-White ionization chamber. The unit is designed to measure from 0.02 roentgens per hr to 500 roentgens per hr on a large, easy-to-read, logarithmic scale. Powered by only 4½ v, without the need of amplification, it has eliminated such troublesome components as vibrators, rectifiers, voltage regulators, capacitors, high megohm resistors and transformers. It measures 5 in. × 3 in. × 3 in. and weighs only 2 lb. It has a performance record of 168 hours of continuous use with no drop in meter reading. Demonstrable accuracy is within less than ±10 percent of radiation intensity shown anywhere on the scale.



Diode Tester

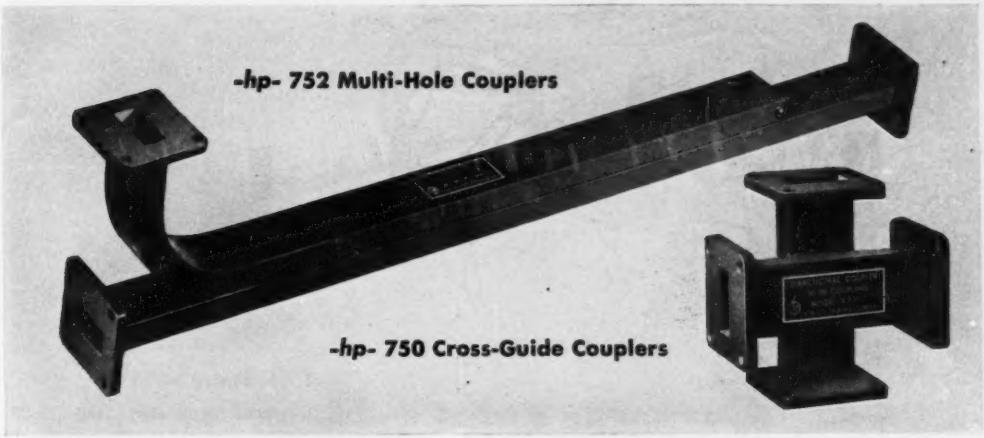
COMPUTER RESEARCH CORP., 3348 W. El Segundo Blvd., Hawthorne, Calif., has developed an instrument for testing the dynamic as well as static characteristics of crystal diodes. Where large numbers of diodes are used in plug-in form, the diode tester can also be used for periodic circuit checks to detect potential diode failures before they occur. The unit occupies a space less than ½ cu ft, and will accommodate diodes with forward currents of 0 to 100 ma and back currents of 0 to 1,000 μa. Forward voltage is measured to an accuracy of 2 percent and back current to 3 percent. The tester is adaptable to high speed, volume testing and operates on 115 v, 60-cycle current, using 100 watts or less.



Pulse Transformer

ENGINEERING RESEARCH ASSOCIATES, INC., 1902 W. Minnehahah Ave., St. Paul W4, Minn., has developed a new multipurpose miniature pulse transformer designed especially for use in low-power applications. Type 130A1 transformer has several features: Its three isolated windings provide versatility of application; compact transformer design permits mounting on a tube strip or chassis in approximately the same space required for a standard miniature tube; short

New! hp DIRECTIONAL COUPLERS



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-*hp*- 752 Multi-Hole Couplers

In this coupler the broad faces of two waveguides are joined together, with coupling obtained from a series of graduated holes. Power is detected by connecting a crystal detector or bolometer mount to the open end of the auxiliary arm. Directivity is better than 40 db entire range. Coupling factors are 10 and 20 db, accuracy of coupling level is ±0.4 db across entire frequency range, and frequency sensitivity is ±0.5 db full range. 5 models for each coupling factor cover waveguide frequencies from 2.6 to 12.4 kmc. The instruments form a 3-terminal network ideal for monitoring power, measuring reflections, mixing or isolating signals.

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-*hp*- 750 Cross-Guide Couplers

These instruments answer most monitoring, isolating or mixing needs where more precise multi-hole couplers are not needed. They consist of two waveguide sections mounted at right angles across their broad faces. Directivity is approximately 20 db, and accuracy of coupling level is ±0.4 db across full range of waveguide. Frequency sensitivity is ±1.3 db. Coupling factors offered are 20 or 30 db, and connections may be made to all four terminals. 5 models for each coupling factor cover frequencies from 2.6 to 12.4 kmc.

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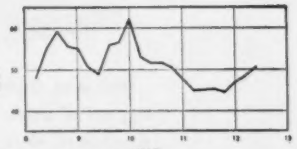

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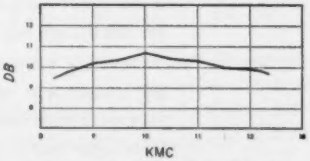

Typical coupling, -*hp*- 752, 10 db model

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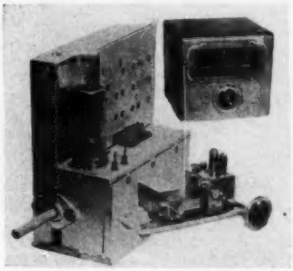
62 PEARL ST., SO. BRAINTREE, BOSTON 85, MASS.

rise time and small droop minimize critical associated circuit design problems. Typical applications include triggering and counting circuits, blocking oscillators, d-c isolation, inversion, pulse-shaping and pulse-transmission circuits.



UHF Tuner

GENERAL INSTRUMENT CORP., 829 Newark Ave., Elizabeth 3, N. J. A new and unique approach to uhf tuners is characterized in the model 60 (illustrated) that features very low noise factor, better sensitivity, no sliding contacts, straight-line-frequency dial calibration and full uhf channel coverage. It can be fitted and mounted in any position around a vhf tuner. A typical application is shown above, where the model 60 is used in conjunction with model 48, 13 position vhf turret tuner, 3-shaft design, with built-in reduction drive for fine tuning.

Selenium Rectifier Tester

GALVANIC PRODUCTS CORP., 110 E. Hawthorne Ave., Valley Stream, N. Y. Model 100A Seletester, for

NATVAR

Silicone Coated Fiberglas

Stearns road magnets are saving airlines, bus operators and motorists from inconvenience and expense of tire repairs by removing tons of nails, spikes, screws, wire, and other scrap metal from runways and highways. In many cases, the metal recovered more than pays for the operation of the magnets. Coils of these highly specialized, heavy-duty magnets are built to last. They are insulated and protected with Natvar Silicone Coated Fiberglas because of its excellent electrical and mechanical characteristics, particularly its ability to withstand heat and moisture.

Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubing and sleeving
- Varnished identification markers
- Lacquered tubing and sleeving
- Extruded plastic tubing and tape
- Extruded plastic identification markers

Ask for Catalog No. 22

Stearns Magnetic, Inc., Milwaukee, manufactures magnetic clutches, brakes, separators, pulleys, drums, and other magnetic devices and equipment for industrial uses, where reliability of performance is essential.

This calls for a highly specialized engineering knowledge of magnetism, its practical application to specific problems, and a thorough familiarity with the characteristics of materials under actual operating conditions. Natvar Silicone Coated Fiberglas was selected for their road magnet because of its proven resistance to heat and moisture.

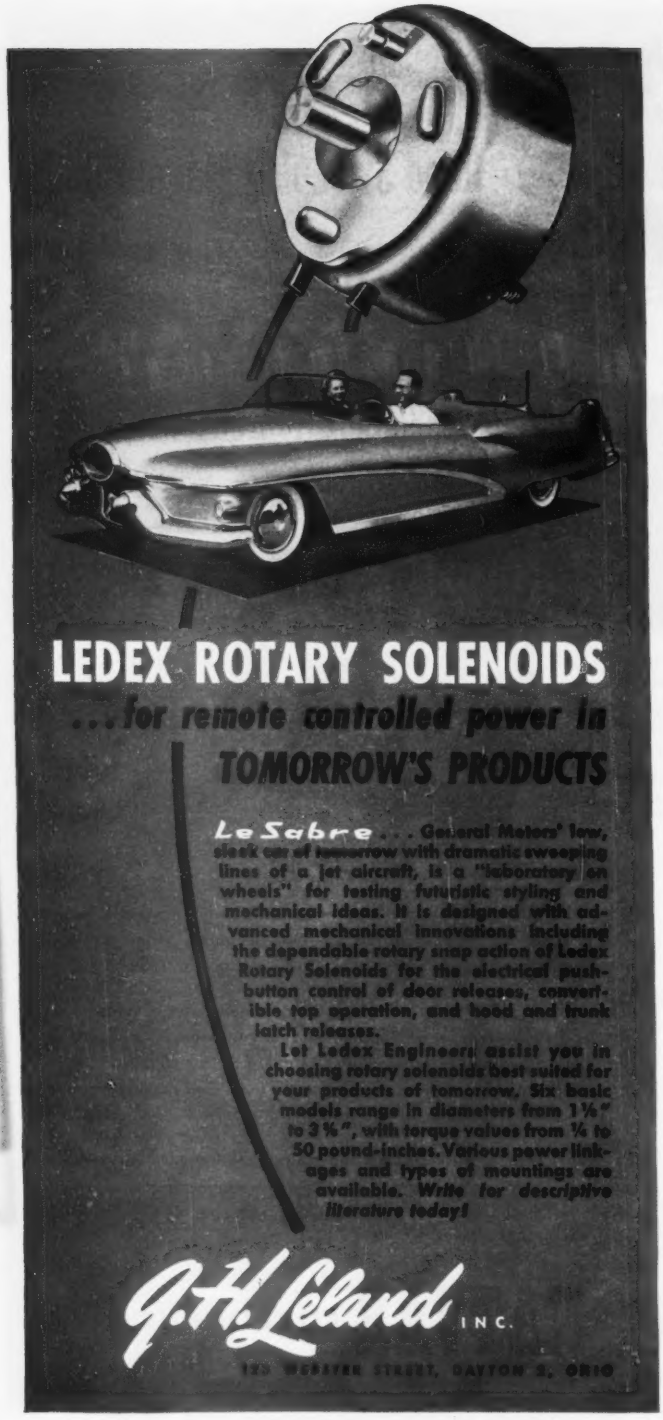
Natvar flexible electrical insulating materials have good electrical and mechanical properties and are consistently uniform, no matter when or where purchased. They are available either from your wholesaler's stock or direct from our own.

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE RAHWAY 7-8800 — CABLE ADDRESS NATVAR: RAHWAY, N. J.

201 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY


LEDEX ROTARY SOLENOIDS
...for remote controlled power in
TOMORROW'S PRODUCTS
LeSabre... General Motors' low, sleek car of tomorrow with dramatic sweeping lines of a jet aircraft, is a "laboratory on wheels" for testing futuristic styling and mechanical ideas. It is designed with advanced mechanical innovations including the dependable rotary snap action of Ledex Rotary Solenoids for the electrical push-button control of door releases, convertible top operation, and hood and trunk latch releases.
Let Ledex Engineers assist you in choosing rotary solenoids best suited for your products of tomorrow. Six basic models range in diameters from 1 1/8" to 3 1/8", with torque values from 1/4 to 50 pound-inches. Various power linkages and types of mountings are available. Write for descriptive literature today!
G. H. Leland INC.
123 WEBSTER STREET, DAYTON 2, OHIO

testing selenium rectifiers as used in radio and tv receivers, provides means for testing for (1) forward resistance, (2) reverse leakage currents, (3) "opens" and (4) "shorts". It provides positive, fast and accurate tests for all stacks rated at 10 to 1,000 ma. The Seletester will also test any new miniature selenium rectifiers which may be introduced, without any adaptors or other equipment. Input is 117 v, 60 cycle a-c.

Inspection Instruments

ENGINEERING DEVELOPMENTS, INC., 32 West Pelham St., Newport, R. I., has introduced its latest types of Magnivision inspection devices and assembly aids. The units are essential for accurate viewing of fine detail for all classes of inspection and assembly of machined parts, wire, tubing, radio parts, crystals, electric relays, meter assembly and many other uses around the shop. Magnivision gives strain free vision, stereoscopic vision, shadowless vision and cool intense light with no discomfort due to heat ordinarily present from filament lamps.

Maintenance Instrument

ANCO INSTRUMENT DIVISION, 4254 West Arthington St., Chicago 24, Ill., has announced the Elec-Detec, a portable electronic maintenance instrument for locating trouble in machinery and other moving mechanisms. This electronic stethoscope helps maintenance men locate friction noises in engines, gears, shafts, transmissions, traps, valves and

There are hundreds of jobs open to engineers today!

but few opportunities like these

Westinghouse is in nuclear power to stay. We believe in the development of atomic energy as man's next great source of power. If you want to get in on a new era in industry, we want to talk to you.

Atomic power opportunities are waiting for electronic engineers with 4 to 10 years of this kind of experience...

ELECTRONIC COMPUTERS, employing pulse amplifying wide range linear amplifying and rate circuits.

NULL BALANCE DEVICES, employing both vacuum tube and magnetic amplifiers, SERVOMECHANISMS, PLANT CONTROL SYSTEMS.

LIAISON with customers, contractors, designers of component equipment.

SUPERVISION of drafting work.

REMEMBER! We are primarily interested in good *experienced* application and development engineers—lack of previous reactor development experience *is no handicap in this type of work.*

HOW TO APPLY! What Westinghouse wants to know is: Where and when you obtained your degree . . . how you did in school . . . where you have worked at your profession . . . what kind of work you have done.

In other words, right now we're more interested in your ability to fill current openings and to develop in the Westinghouse Atomic Power Division than we are in your vital statistics. Write your letter of application accordingly.

You will be in communication with men who are experienced in keeping secrets. All negotiations will be discreet, and your reply will be kept strictly confidential.

Address your application letter to: Manager, Industrial Relations Department, Westinghouse Electric Corporation, P. O. Box 1468, Pittsburgh 30, Pennsylvania.

What do you want?

MONEY? Good jobs are open here now—waiting for good men who want to make a permanent connection.

A PERMANENT JOB? Many of the engineers who joined Westinghouse 20 and 25 years ago are still with Westinghouse—and in key positions—and engineers who join us now will have the opportunity to make this work their lifetime careers. When many other industries may be going through slack times, atomic energy will still be in a stage of expansion.

SUBURBAN LIVING? It's here—within easy driving distance of your work. Within a few minutes of shopping centers . . . schools . . . metropolitan centers.

JOB EXTRAS? Westinghouse offers: Low cost life, sickness and accident insurance with hospital and surgical benefits. A *modern* pension plan. Westinghouse stock at favorable prices. Westinghouse appliances for your home at discount.

YOUR KIND OF ASSOCIATES? Every fourth person in the Division is an engineer or scientist. More than half the top Westinghouse executives are engineers.

FASCINATING WORK? What other branch of science offers such exciting challenges? So many opportunities for discovery? So many chances to benefit mankind? So many opportunities for original work?

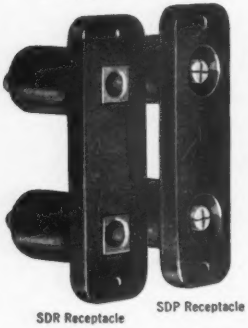
GROWTH OPPORTUNITIES? Never again in your lifetime will you be able to get into such a sure-to-expand industry so early in its development.

YOU CAN BE SURE.. IF IT'S Westinghouse

CANNON PLUGS *for laboratory and switchboard*

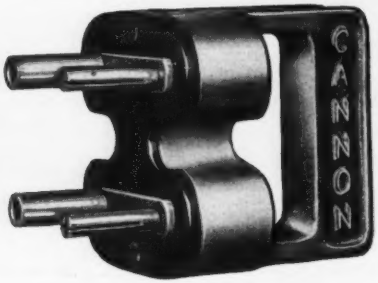
CSR Tandem Receptacle
CSP Plug

Here are a few examples of Cannon's Experimental Laboratory and Switchboard Connectors. They are used extensively throughout industry, public utilities, sound studios, broadcasting stations, college and university physics and chemistry laboratories, in AC network analyzers and electronic analog computers. They may be applied wherever quick disconnect switching



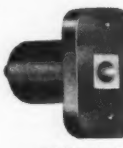
SDR Receptacle

SDP Receptacle

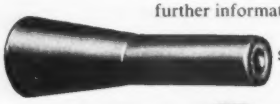


SWPR-4 Switching Plug having both pin and socket contacts

and patch cord plugs are required. High grade materials are used throughout. Molded phenolic of high dielectric strength is used for insulation. Both pin and socket contacts are machined from solid brass. Some are silver plated. All are rated at 75 amps. Pin contacts are split for low loss seating in tapered bore sockets. Single contact fittings are supplied in either red or black phenolic to designate direct or alternating current circuits respectively. Two-contact and larger plugs have sand-blasted cast aluminum shells and handles with clear lacquer finish. Various combinations of pin and socket contacts are used as a polarizing guide. For further information write for Bulletin LS5-1951.

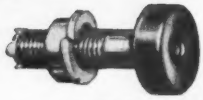


SR Receptacle



SCR Plug

SCP Plug



SRB Receptacle

CANNON ELECTRIC

Since 1915

Factories in Los Angeles, Toronto, New Haven, Benton Harbor. Representatives in principal cities. Address inquiries to Cannon Electric Company, Dept. J-120, P. O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif.

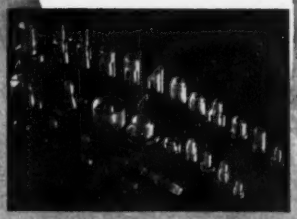
REXOLITE 1422

(FORMERLY G. E. TEXTOLITE 1422)

THE *Better* PLASTIC U. H. F. INSULATION

BECAUSE OF:—

- outstanding electrical properties
- superior machinability
- high heat resistance
- dimensional stability
- and extremely low initial cost



Rexolite 1422 has been specifically designed and developed to meet the growing need for a lightweight — low cost U. H. F. insulating material.

Rexolite 1422 is available for immediate delivery as centerless ground rod in any diameter up to 1". Also cast in larger diameter rods and sheets.

Meets JAN-P-77 and MIL-P-77A specifications.

The unusual chemical inertness and physical properties of Rexolite 1422 allow its use where other materials fail.

For use in: connectors, coaxial connectors, waveguide, antennas, leads and spacers, spreaders and air wound coil supports, coil forms.

Write today for technical bulletins and samples. Our engineering staff is always at your disposal.

Manufacturers of Non-strip wire, High Temperature Electrical Tubing and other extruded plastic products.

THE REX CORPORATION
63 LANDSDOWNE STREET
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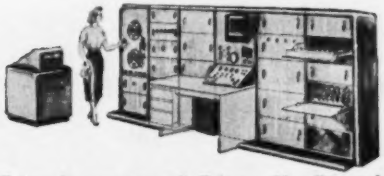
ASCOP

PRECISION ENGINEERING IN ELECTRONICS

Telemetering and Data Handling Equipment

Special Components

GROUND STATION EQUIPMENT



Installations for reception and all forms of handling and reduction of data from pulse width and FM/FM radio telemetering systems • Custom-engineered and custom-built to hold equipment to a minimum consistent with accuracy, operation ease, reliability • Functional mounting of components assures servicing ease – and flexibility for ready unit expansion with any of the following:

- *Specialized receiving equipment*
- *Magnetic tape field storage and playback*
- *Regenerative integrator for PM signals*
- *Channel selector for PW systems with automatic zero and channel sensitivity adjustments, and automatic missing pulse insertion.*
- *Oscillographic film reader, with line center finder*
- *Tabulated numerical output*
- *Punched card output*
- *Graphical output*

DATA HANDLING EQUIPMENT

Automatic or semi-automatic devices for marked reduction of time, expense, man-power usually required to place volumes of recorded data in final usable form • Input data – film records, varying DC voltages, magnetic tape recordings, etc.– processed point by point, at high rates, with automatic correction for zero drift, scale factor, and measuring system non-linearities • Outputs available as continuous plots on film or paper, with scale and time coordinates, as DC voltages, as pulse coded signals for remote transmission, or as electrical indications for existing tabulating and card punching devices • All systems custom-designed for accuracy and economy; custom-assembled from special purpose components devised in continuous engineering of data handling systems.

ASCOP

WE PROVIDE THE LEVER • YOU MOVE THE WORLD

Your Inquiries Are Invited • Write or Telephone

Applied Science Corp. of Princeton

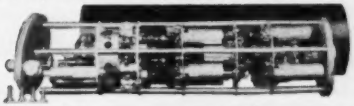
P. O. Box 44, Princeton, N. J. PLainsboro 3-4141

PULSE WIDTH RADIO TELEMETERING

PW/PM Small, rugged units particularly suited to vehicular use where many different variables must be continuously transmitted.

- 30 data channels
- 215-235 mc Carrier-crystal controlled
- Based on RDB telemetering standards
- 4 watt RF power output
- 30 cps sampling rate
- 1% system accuracy
- ½% linearity
- 0-5 volt DC inputs
- 60 g sustained acceleration
- –40° to +60°C
- Vibration –⅛ in. at 60 cps
- Single or two package form
- 3¼ in. diam.; 17 in. length; 7 lbs. weight
- Primary power 28 volts, 3.5 amps

Note: Also available without dynamotor. Transmitters available separately. Integral subcommutator if more channels are desired



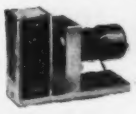
PW/FM For higher power output, with space no factor. Stable, highly reliable over long distances. Components readily accessible for replacement to extend unit life.

- Based on RDB telemetering standards
- 215-235 mc Carrier
- Max. drift – .04%
- 10 watt RF power output
- 30 data channels
- 30 cps sampling rate
- 1% system accuracy
- ½% linearity
- 0-5 volt DC inputs
- 60 g sustained acceleration
- Vibration: ⅛ in. at 60 cps
- 10 kc oscillator supply for AC pickups included
- 4¼ in. diam.; 30 in. combined length; 17 lbs. combined weight
- Primary power 28 volts at 5.7 amps.

Note: Model PAD-1 Power Amplifier-Dynamotor unit may be added to increase transmitter power to 40-50 watts. Transmitter of Transmitter-Dynamotor packages available separately.

HIGH-SPEED ROTARY SAMPLING SWITCHES

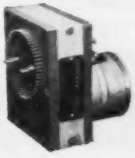
ASCOP designs and manufactures switches to your most difficult and exacting requirements. Here are a few typical examples



TYPE T Built to withstand vibration, shock, temperature and altitude extremes. Switching designed for airborne radio telemetering systems. DC motors for 27, 12, and 6 volts. Up to 4 poles, each with 30 contacts. Sampling speeds from 0.1 to 20 rps.

TYPE U Custom-designed for limited space applications. Complete with DC drive motor, yet only 1 in. in diameter. A single pole samples 32 fixed contacts at the rate of 100 rps.

TYPE L For high performance with space secondary. Single pole samples 120 fixed contacts at rates up to 30 rps. Connection to external drive through ¼ in. steel shaft running in sealed ball bearings. Special contact material for long service-free life.



TYPE V For precision in sampling speed plus long life. Synchronous drive motor permits selection of single pole sampling of 60 fixed contacts at many rates from 1 rps. to 1 rev. per day. Adaptable, through variety of mountings and terminals, for use as a component of industrial instrumentation systems.

HIGH SPEED Potter INSTRUMENT COMPANY, INC. ELECTRONIC

COUNTING TIMING CONTROL

INSTRUMENTS

FOR APPLICATIONS INVOLVING THESE BASIC MEASUREMENTS

CALCULATION + — ÷ X

For business, industrial and scientific applications requiring computation, data handling, memory and high speed printing, the Potter Instrument Company can supply complete systems. Some of the newly developed equipments include simplified electronic arithmetic units, multipurpose shift registers, storage devices, photoelectric readers, tape handlers and high speed line-at-a-time printer.

QUANTITY

Pills, buttons, bottle caps, hardware, etc., can be counted and batched in precise predetermined quantities at speeds up to 60,000 per minute. Important savings in labor and overages are assured by the speed and accuracy of the Potter Electronic Counter. Count Detectors for any product are available.

LENGTH

Wire or strip material can be automatically sheared or marked in precise predetermined lengths at high rates of speed, and if required, automatically stacked in predetermined quantities. Practically any definition of measurement can be obtained

TIME

Time intervals can be easily measured or generated with extremely high accuracy through the use of Potter Counter Chronograph Interval Timers. Registration of measurement is retained until reset. Accuracy of one part in 8,000,000 can be provided.

SEQUENCE

Since the electronic counters can be arranged to predetermine any sequence of selected counts, they can be readily and advantageously substituted for cams, gears, patterns, chains and other systems of timing control. Control by absolute count assures high accuracy, faster operating speeds, since there are no moving parts to wear.

FREQUENCY

Potter Electronic Counters provide an exact ratio of division which is maintained even though the input frequency is varied. If the input frequency is stopped the output also stops. Frequencies can be measured or generated with high precision. Square waves of variable frequency, pulse-width and number can be easily generated.

REVOLUTION

Through electromagnetic or photoelectric pickup, shaft rotation can be accurately counted or timed without physical contact. Fractional parts of a revolution can be measured or used to control automatic machine processes as a function of predetermined counts.

PROBLEMS ?

Your specific counting, timing or control problem, explained on our data sheet, will result in a prompt and efficient solution by our engineers.

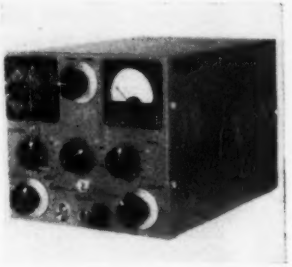
WRITE FOR DESCRIPTIVE CATALOG NO. 38

POTTER INSTRUMENT COMPANY

INCORPORATED

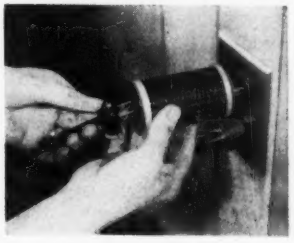
113 CUTTER MILL ROAD, GREAT NECK, NEW YORK

pipe lines. The instrument uses a metal probe which serves as a microphone to locate the exact source of tell-tale noise. Noise impulses are transmitted through an amplifier to headphones.



Mobile Transmitter

E. F. JOHNSON CO., Waseca, Minn. Designed primarily for under-dash mounting in autos, the Viking mobile transmitter is capable of 60 w input, 100-percent a-m modulated, on the 75, 20 and 10 meter amateur bands. The unit is completely bandswitched and has provisions for one additional band. Additional features include: receiver muting, front panel audio gain control, gang tuning and provision for push-to-talk operation.

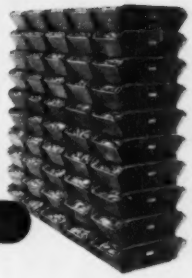


TV Ballast

CLAROSTAT MFG. CO., INC., Dover, N. H. The tv ballast is designed primarily to be plugged in between tv set and electric receptacle, for use in areas where line voltage tends to increase up to 140 v. The unit operates on the ballast principle, whereby, as voltage increases, the resistance increases, giving an increased drop across the resistance, thus allowing a lower poten-

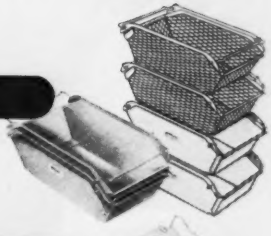
STANDARD BOXES *for* SPECIAL JOBS!

No matter what business you are in—or what problems you have in handling small parts, there is a standard NesTier custom-made to fit your requirements. A production line product, the NesTier effects savings in initial cost as well as on the job—from stock room to loading dock.



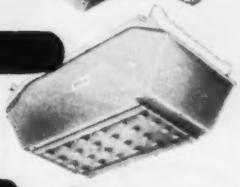
STOCK ROOM OR STORAGE

Nowhere else will you find a box that will serve alone as a permanent stock room fixture. No racks are necessary as tiered units lock themselves together to form rigid stacks. Parts in all units are visible and accessible.



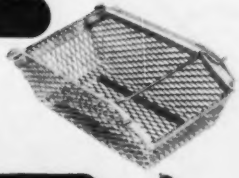
PRODUCTION

NesTiers were designed primarily for production line work. Empty, they nest to save space. Filled and tiered, they lock together with contents of all units visible and accessible. Filled or empty, they are easily transported by truck, roller or overhead conveyor—even by hand.



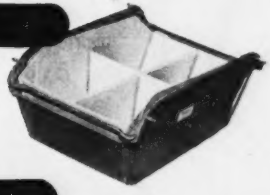
DRAINAGE

Here is the standard one-piece sheet steel NesTier with a lanced bottom that permits rapid drainage of contents without allowing even the smallest parts to slip through. No need to transfer parts requiring drainage when this box is used.



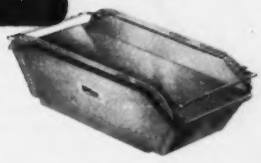
DEGREASING

The necessity to change boxes for any cleaning, dipping or degreasing operation has been eliminated with this NesTier expanded metal basket. Formed in the distinctive NesTier shape, this unit is as rugged as the solid sheet steel box and retains all of the outstanding NesTier features.



PROTECTION

NesTier fibre inserts actually perform two functions. Parts are protected against damage from metal box and a variety of parts may be placed in one box without becoming mixed. Furnished with or without dividers.



SHIPPING

The NesTier one-piece "snap on" lid keeps parts from jouncing out while being transported through the plant or from plant to plant. Filled units with lids attached can be tiered, allowing parts to be stored or transported and yet keep clean.

NesTiers are formed of one-piece sheet steel, with or without lanced bottom; zinc plated expanded metal, galvanized, stainless steel or aluminum. All units and accessories interchangeable. Two standard sizes.

NESTIER
IT NESTS - IT TIERS

THE CHAS. Wm. DOEPKE MANUFACTURING CO., INC.
METAL SPECIALTIES DIVISION ROSSMOYNE, OHIO

GTC Transformers

demanded for

Unusual Applications

The illustrated new automatic pin-spotter is a product of the American Machine & Foundry Company. An exceptionally high degree of precision is necessary for proper performance.

"GTC" Transformers are used in the AUTOMATIC PIN-SPOTTER because of their accepted ability to meet the most rigid specifications. If your application is most unusual or standard, we suggest you consider "GTC" — proven transformers where maximum performance is essential.

We welcome your inquiries.

GENERAL TRANSFORMER COMPANY

serving industry since 1928

18240 Harwood Avenue, Homewood, Illinois

(Suburb of Chicago)

Understand TV Technology

fundamentals

• circuits • equipment

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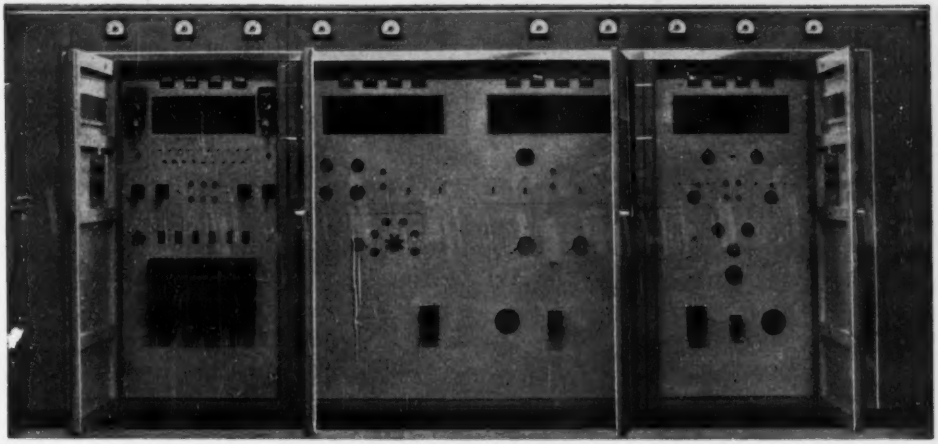

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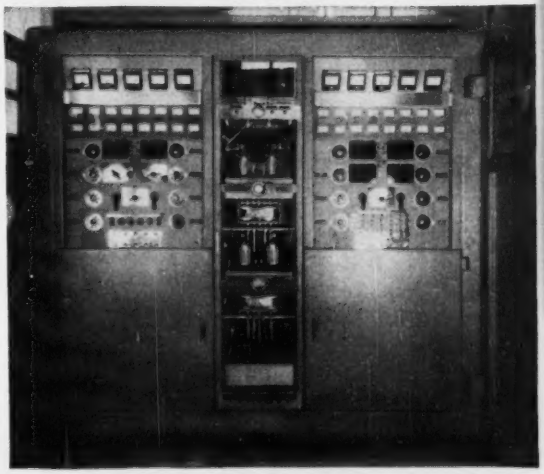

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tial to be applied to the tv set. At 110 v and under, the voltage drop is negligible; but with increases up to 140 v, the voltage applied to the tv set will not normally increase much above 115 v, depending on the load applied. They are available in type TVA, 200 to 300 w; and type TVB, 300 to 375 w.

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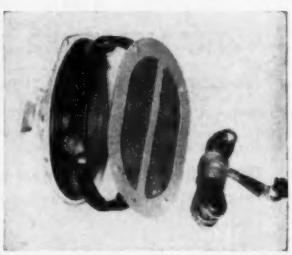


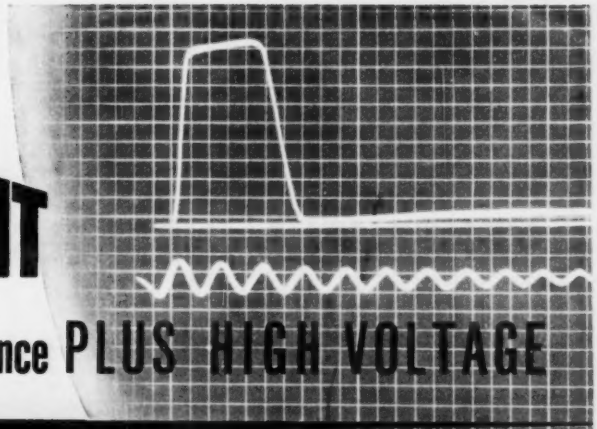
Auto Speakers

QUAM-NICHOLS CO., Chicago, Ill., has announced two new rear seat auto speakers. Model AS-1 kit includes a 6½-in. p-m. Adjust-A-Cone

Another new instrument by

DU MONT

Type 303-A Performance PLUS HIGH VOLTAGE



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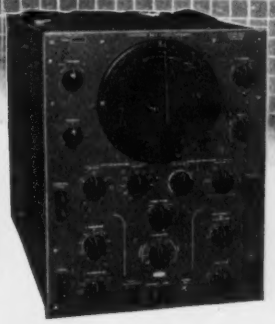

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- Y-Frequency Response: Down less than 30% at 10 cps and 10MC at any setting of attenuator or gain control.
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THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" — "they" being all the industry's front line of innovators and improvers—and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

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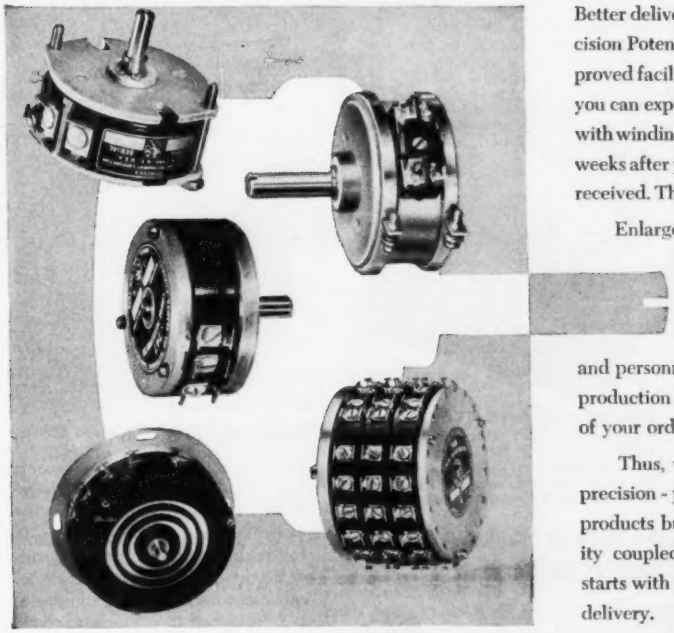
Sample Precision Potentiometers now available in 4 to 6 weeks



Better delivery than ever before of Fairchild Precision Potentiometers is the result of recently improved facilities and additions to personnel. Now you can expect delivery of sample standard units with windings to meet your requirements in 4 to 6 weeks after your final approved specifications are received. The same reasonable prices prevail, too.

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1. Shaft is centerless-ground from stainless steel to a tolerance of +0.0000, −0.0002 in. which, together with precision-bored bearings, results in radial shaft play of less than 0.0009 in.

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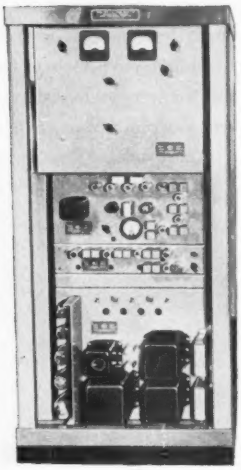
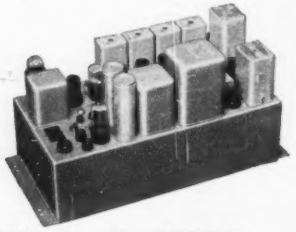


REL specifies and uses CHICAGO

You'll find CHICAGO "Sealed-in-Steel" transformers used throughout REL's FM Transmitting and Relay Equipment. Absolute dependability is a prime requirement in *all* REL equipment—and CHICAGO transformers contribute significantly to quality, superior performance and long time stability.



COLLINS specifies CHICAGO

This COLLINS MHF Single Frequency Communications Receiver utilizes CHICAGO "Sealed-in-Steel" transformers for trouble-free, continuous service under the most rugged operating conditions.

where the going's tough—specify CHICAGO "Sealed-in-Steel"

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CHICAGO "New Equipment" transformers (available in 3 mountings) feature one-piece drawn-steel cases—the strongest, toughest, best-looking units you can buy. The one-piece seamless design, enclosing an electronically perfect construction, provides the best possible electrostatic and magnetic shielding, with complete protection against adverse atmospheric conditions. For *every* application: Power, Bias, Filament, Filter Reactor, Audio, MIL-T-27, Stepdown—ask your electronic parts distributor for CHICAGO "Sealed-in-Steel" transformers.

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Hermetic sealing meets all MIL-T-27 specs. Steel base cover is deep-seal soldered into case. Terminals hermetically sealed. Ceramic bushings. Stud-mounted unit.

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Steel base cover fitted with phenolic terminal board. Convenient numbered solder lug terminals. Flange-mounted unit.

C-TYPE

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speaker with capacity to handle the full ouput of any single-ended auto set. It has a 1.47-oz Alnico V magnet. Model AS-2 kit includes a heavy-duty 6 × 9-in. p-m Adjust-A-Cone speaker with capacity to handle the most powerful auto set made. It has a 2.15-oz Alnico V magnet. Both types feature rugged 3-position switch for dash mounting and ample cable, flocked grill screen, baffle plate, miscellaneous hardware and installation instructions.

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MARION ELECTRICAL INSTRUMENT Co., 401 Canal St., Manchester, N. H., has introduced a new hermetically sealed running time meter for registering the operating time of machine tools, electronic, electrical or general industrial equipment. It is designed to perform perfectly in a wide range of temperatures and in hazardous atmospheres. The unit is powered by a self-starting synchronous motor, available for 110 to 125, 220 to 250 v, 50 or 60 cycles a-c.

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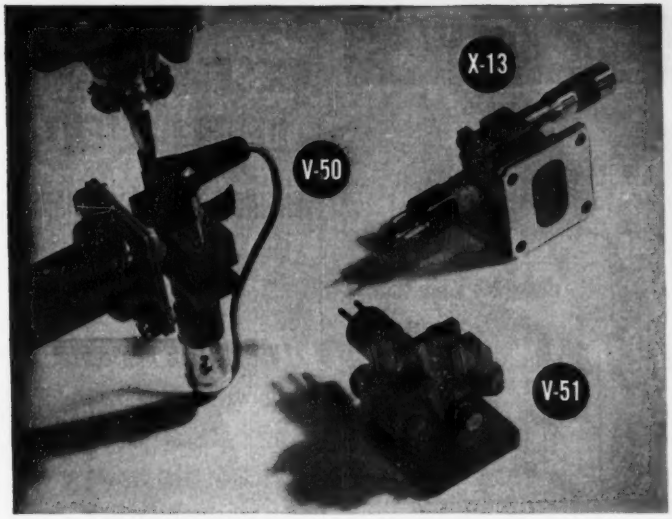
SIMPSON ELECTRIC Co., 5200 W. Kinzie St., Chicago 44, Ill. With the model 485 cross hatch pattern



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Development based on the widely-used Varian X-13 klystron has produced two new Varian tubes with unusual possibilities for X-band applications involving extreme shock and vibration.

V-50 RUGGED, TUNABLE RADAR LOCAL OSCILLATOR. Here is a tube capable of withstanding severe vibration and shocks well beyond 30 times gravity It is tunable with extreme smoothness over the band from 8.5 to 10.0 kmc, and can be used with conventional afc circuits. Power output is 25 milliwatts, minimum, with a resonator voltage of 300 volts. The output connector mates with UG39/U flange (1 x ½" waveguide).

V-51 RUGGED RADAR L. O. OR LOW-POWER TRANSMITTER. Lock-nut tuning enables the Varian V-51 klystron to withstand even rougher treatment than the V-50. Frequency range, application, and construction are otherwise similar. Tuning is easily done in the field with a standard open-end wrench. This tube is capable of 75 milliwatts, minimum, at 350 volts on the resonator. The output connection also mates with a UG39/U flange.

X-13 GENERAL-PURPOSE X-BAND SIGNAL SOURCE. A versatile, stable, reliable, laboratory-type signal source, the familiar Varian X-13 klystron tunes readily with a built-in micrometer device over a wide frequency range of 8.2 to 12.4 kmc. The X-13 is not intended for rugged service. It delivers well over 100 milliwatts at a resonator voltage of 500 volts. Output connection is a UG39/U flange.

Send for your copies of data sheets giving full information about this group of X-band Varian klystrons. There is a Varian Associates field representative nearby to assist on any application problems you may have.

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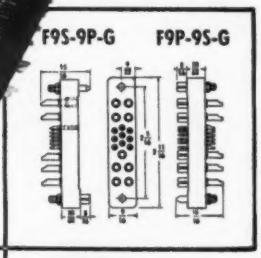

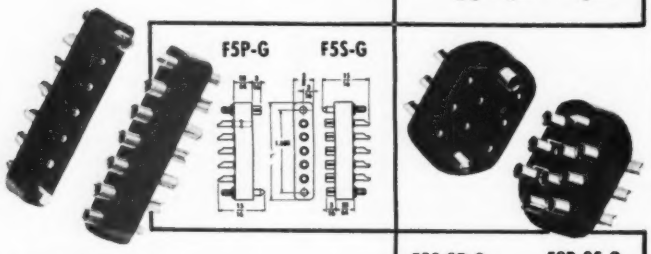

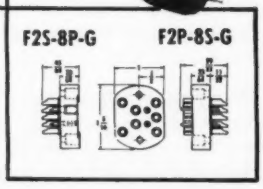

NEW DESIGNS for electronic equipment in aircraft and guided missiles have required circuit connectors with special contact sizes and arrangements. The above connectors are typical of several recent designs we have supplied to meet this need. Winchester's staff of experienced engineers is prepared to help you with your "special" connector problem.

PHYSICAL AND ELECTRICAL DATA

Plug Code No.	Receptacle Code No.	Small Contacts: Number of Contacts	Small Contacts: Solder Cup Dia. In.	Large Contacts: Number of Contacts	Large Contacts: Solder Cup Dia. In.	Weight—Oz.: Plug	Weight—Oz.: Rec.	D. C. Volts Breakdown Between Contacts: Sea Level Normal Humidity	D. C. Volts Breakdown Between Contacts: 60,000 Feet Altitude
F5P-G	F5S-G	—	—	5	.081	.5	.6	4500	1100
F2P-8S-G	F2S-8P-G	2	.043	8	.081	.8	.7	4500	1100
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PRECISION MACHINED CONTACTS: Pins from brass bar (QQ-B611) and sockets from spring temper phosphor bar (QQ-B746a). They are gold plated over silver for consistent low contact resistance, reduction of corrosion and ease of soldering.

POLARIZATION: Guide pins and guide sockets assure positive engagement.

RACK AND PANEL MOUNTING: Either plug or receptacle may be mounted on a panel or chassis.

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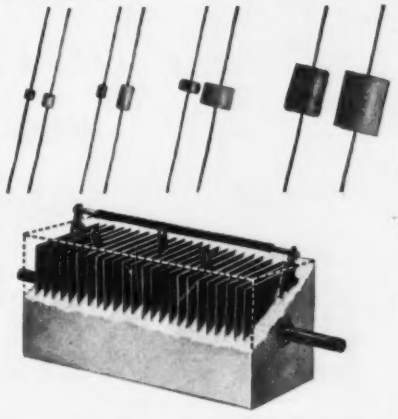

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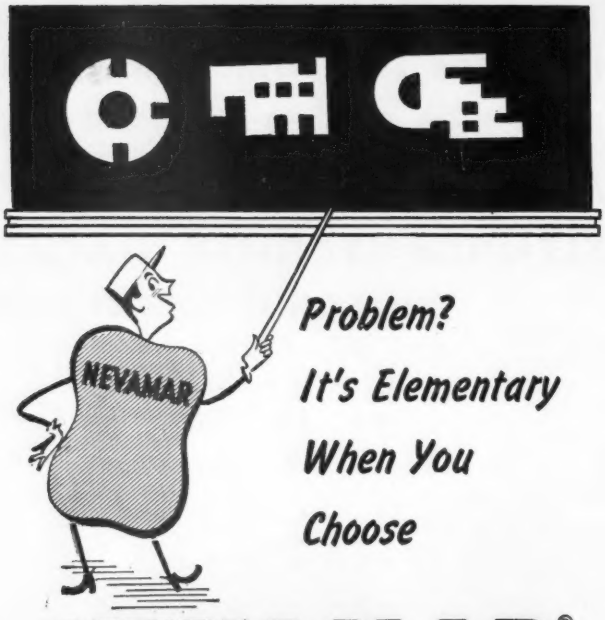

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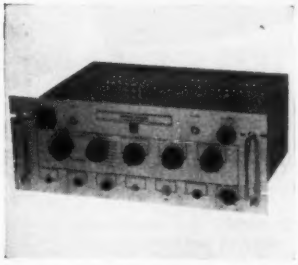
generator, horizontal and vertical linearity, hold, height, width and drive adjustments may be made easily and quickly when transmitter test patterns are not available. It provides a synchronized signal, modulated on the carrier frequencies of channels 2 through 6, which can be tuned and sent through the receiver under test. When the receiver has been properly adjusted, the signal will show equally spaced lines in vertical, horizontal or cross-hatch patterns on the picture tube. All patterns are locked in place with synchronizing pulses, exactly the same as the sync pulses in transmitted waveforms, making it unnecessary to double check against actual transmitted test pattern. The output cable includes a variable termination network which is quickly adapted to provide 75 or 300-ohm terminations.



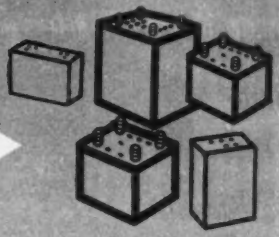
Universal Amplifier

THE BRUSH DEVELOPMENT CO., 3405 Perkins Ave., Cleveland 14, Ohio. Model BL-360 universal amplifier for rack mounting was designed for use with magnetic direct-writing oscillographs in studies of static or dynamic strains up to 100 cps when measured by the use of resistance-sensitive strain gages. The instrument was designed for use with the SR-4 120-ohm strain gage but may be used with any gage type with ohmic resistance of 50 to 1,000 ohms. Measurable range of the unit is 10 to 40,000 μ in. per in. with one active gage. Sensitivity is increased 4 times by use of 4 active gages. The control panel contains a 10-step attenuator, terminals for connection of strain gages, calibration resistor holder, resistance and capacitance bridge balance controls,

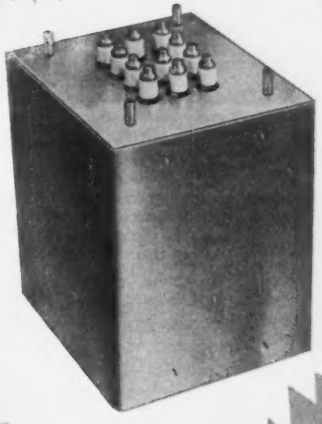
Heldor's "PACKAGE" will save you plenty

not this

and this



but this!



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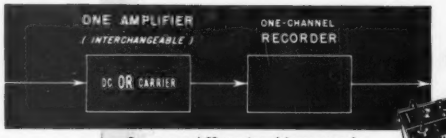
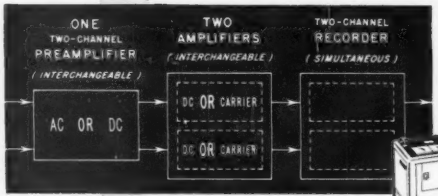


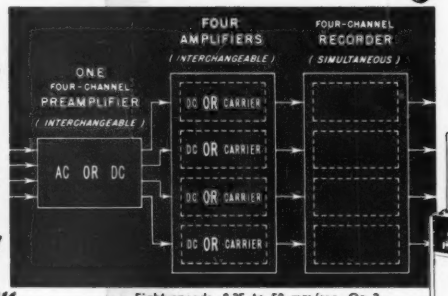
ONE channel

Paper speed 25 mm/sec (slower speeds available). All systems record without ink in true rectangular coordinates.



TWO channel

Five dual sets of speeds, from 0.5 to 100 mm/sec. Channels on 2 and 4 channel systems operate independently of each other, register simultaneously on one record.



FOUR channel

Eight speeds, 0.25 to 50 mm/sec. On 2 and 4 channel systems, user may record in number of channels he chooses, on corresponding widths record paper.

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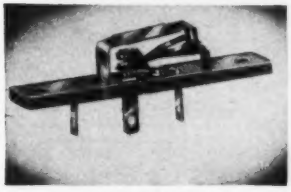
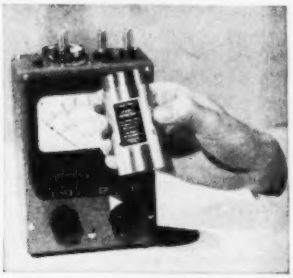
gain controls and pen centering control. The amplifier contains a 2,000-cycle bridge energizing oscillator, high-gain a-c amplifier, phase-sensitive discriminator and d-c output amplifier.



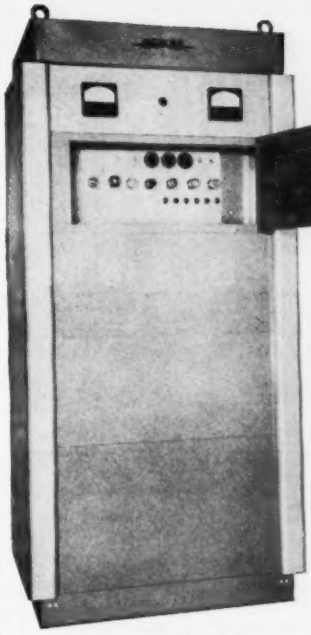
Snap-Acting Switch

THE W. L. MAXSON CORP., 460 W. 34th St., New York 1, N. Y. Wherever electrically operated apparatus has limited space for switch installation, the new Unimax type E switch offers an answer to the control problem. Requiring only $1\frac{1}{4} \times \frac{7}{16} \times \frac{3}{4}$ in., exclusive of terminals and terminal strip, the miniature switch will handle a resistive load of 10 amperes at 125 v a-c and 5 amperes at 250 v a-c. Its contacts have positive wiping action that makes the switch adaptable to use with tungsten-filament lamp loads.



Static Detector

KEITHLEY INSTRUMENTS, 3868 Carnegie Ave., Cleveland 15, Ohio, has announced the model 2005 static detector, a device that clips onto a v-t electrometer providing a convenient combination for detecting and locating static charges. The new electrometer accessory consists primarily of two concentric tubes and an aluminum rod. When clipped over the high terminal electrode of



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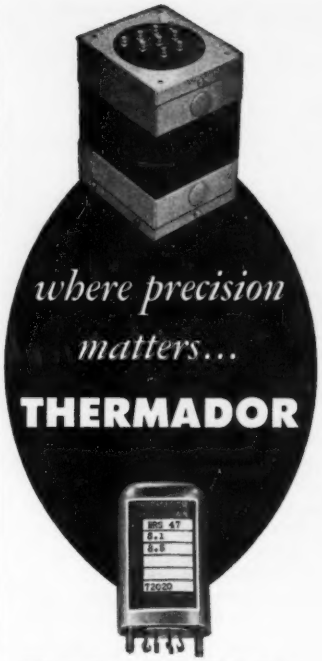

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3-320

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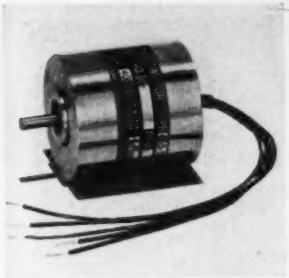
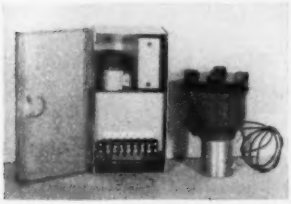
the electrometer, the tubes provide shielding which gives charges along the cylinder axis the most effect. Results are qualitative and observed by noting the deflection of the meter pointer. Many uses are cited for the instrument, such as locating charged bobbins in textile mills, detecting charges on moving paper in printing plants, and for sensing dangerous charges in explosives plants.



Precision Servo Motors

G-M LABORATORIES INC., 4300 N. Knox Ave., Chicago 41, Ill., has introduced a small precision servo motor measuring 1.7 in. in diameter and 1¾ in. long, for frequencies varying from 60 to 400 cycles, and in 2, 4 or 8-pole construction. Stall torque is approximately 2 in. oz. The extreme precision required in these motors involves tolerances as small as ±0.0001. The motors can be supplied to meet rigid military specifications with regard to humidity, temperature, range, vibration and altitude.



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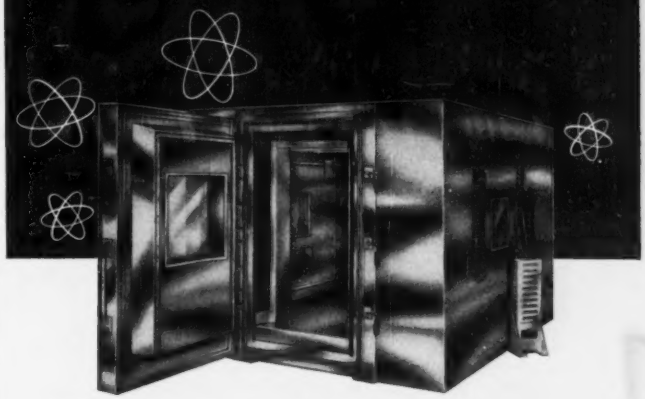

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Transmitters	AY201-1	26V, 400~, 1 ph.	225	1.25	25+j115	11.8	9.5	3.5	15
	AY201-4	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	20
Receivers	AY201-2	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	45
Control Transformers	AY201-3	From Trans. Autosyn	Dependent Upon Circuit Design				42.0	10.8	15
	AY201-5	From Trans. Autosyn	Dependent Upon Circuit Design				250.0	63.0	15
Resolvers	AY221-3	26V, 400~, 1 ph.	60	0.35	108+j425	11.8	53.0	12.5	20
	AY241-5	1V, 30~, 1 ph.	3.7	—	240+j130	0.34	239.0	180.0	40
Differentials	AY231-3	From Trans. Autosyn	Dependent Upon Circuit Design				14.0	10.8	20

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Transmitters	AY503-4	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	25.0	10.5	24
Receivers	AY503-2	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	23.0	10.5	90
Control Transformers	AY503-3	From Trans. Autosyn	Dependent Upon Circuit Design				170.0	45.0	24
	AY503-5	From Trans. Autosyn	Dependent Upon Circuit Design				550.0	188.0	30
Resolvers	AY523-3	26V, 400~, 1 ph.	45	0.5	290+j490	11.8	210.0	42.0	30
	AY543-5	26V, 400~, 1 ph.	9	0.1	900+j2200	11.8	560.0	165.0	30
Differentials	AY533-3	From Trans. Autosyn	Dependent Upon Circuit Design				45.0	93.0	30

For detailed information, write to Dept. C.

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Contact dwell:.....74% min.
Operating Temp.:.....—40°C to 85°C
Overall size (approx.):.....3-11/32 L x 2-1/32 W x 2-7/8 H
Mounts:.....4 No. 4-40 x ¼ studs
Mtg. Dimensions:.....1-23/32 x 2-29/32
Dielectric strength.....200 V. DC each terminal to case

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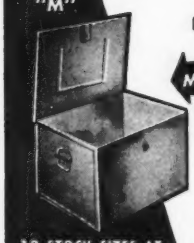

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DOLIN METAL PRODUCTS INC.
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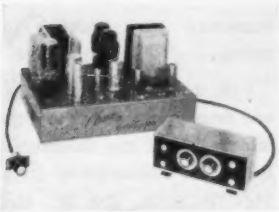
strument designed for controlling and indicating liquid levels, especially in those applications beyond the scope of the conventional liquid level controls. The unit has no electrodes, thereby eliminating danger of shock or explosion. It operates equally as well on nonconductive liquids as it does on conductive liquids. Parts exposed to the liquid are normally made of stainless steel and can be made of other corrosion resisting materials such as glass or ceramic. If the proper size wire is provided between the float and the control to avoid voltage drop, the control can be located at a considerable distance from the float.



Home Music Amplifier

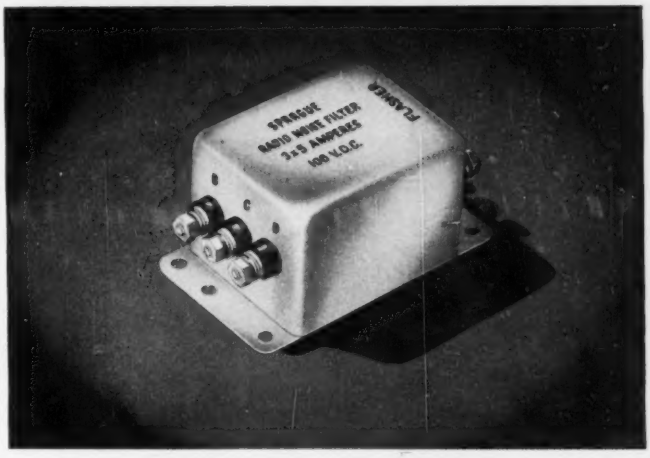
NEWCOMB AUDIO PRODUCTS CO., 6824 Lexington Ave., Hollywood 38, Calif., has introduced the Classic 25 amplifier with complete remote control unit. Frequency response extends from below 10 to over 100,000 cycles. A newly developed Audibalance permits one to achieve perfect balance of output tubes in seconds. Six inputs are provided for radio, tv, tape recorder, crystal and 2 magnetic pickups. A crossover selector simplifies attainment of correct playback response, includes foreign and domestic frequencies and the new AES standard.

Resonant Amplifier

KALBFELL LABORATORIES, INC., P.O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif., has available a new type of resonant amplifier giving high-Q performance at very low frequencies, as well as at audio frequencies. The compact plug-in unit measures 2 × 2 × 4¾ in. The well known method of incorporating a twin-T filter in the feedback loop of an amplifier is employed, but

New Flasher Light R-F Noise Filter

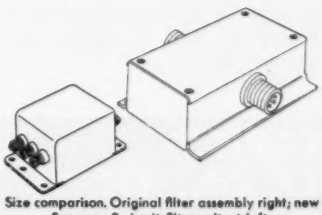
Weight cut 50%; volume reduced to 29% of original on radio interference filter for flashing navigation lights



One of the first tasks before the recently opened Western radio noise suppression laboratory of the Sprague Electric Company, at 11325 Washington Boulevard, Culver City, Calif., was a difficult radio interference problem concerning flashing navigation lights on a new plane design.

Working with another supplier, the aircraft manufacturer's engineers had developed a filter assembly made of three general purpose filters, assembled in a special housing. The completed filter assembly was 41 cubic inches in volume and weighed 30 ounces. It involved not only procurement of all component parts, but costly engineering drawing, production and assembly operations on the part of the airplane manufacturer.

▶ **The size and weight** of this three-circuit filter were a disappointment, and one of the aircraft engineers mentioned this casually to a Sprague field engineer. Only three weeks remained before the plane design was to be frozen but the Sprague engineer volunteered to see what could be done. Well within the allotted time, the Sprague laboratory came up with the answer, shown in the photograph. The new Sprague filter, designed specifically for the application, is only 12 cubic inches in volume and weighs only 15 ounces, yet has superior attenuation characteristics to the unit it replaces. And it is furnished complete and ready for installation!



Size comparison. Original filter assembly right; new Sprague 3-circuit filter unit at left.

▶ **Today,** from the production facilities of the world's largest capacitor factory in North Adams, Mass., Sprague filters are regularly meeting West Coast plane manufacturers' production schedules.

Since the design of this filter, Sprague's West Coast Laboratory has proven equally as helpful on crash programs in more than a dozen other critical situations. Sprague engineers both at Culver City and at the Central Research and Development laboratories in North Adams are fully acquainted with the critical problems that call for "tailoring" filters to meet specific mounting, vibration, and shock requirements, as well as the severe minimum insertion loss limits of today's newest military electrical and electronic gear.

▶ **Sprague engineers** will recommend one of several thousand existing designs if these fill the bill, but they do not hesitate to roll up their sleeves on those "specials" which are fast becoming standard as the aircraft industry forges ahead.

A telephone call to Sprague's Culver City office—TExas 0-7491, or to the executive offices in North Adams—North Adams 423, will enlist the services of a Sprague filter engineer without obligation on your part.

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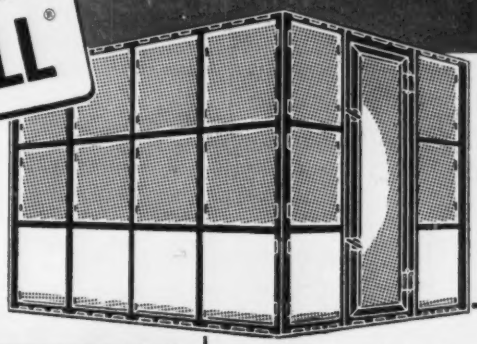

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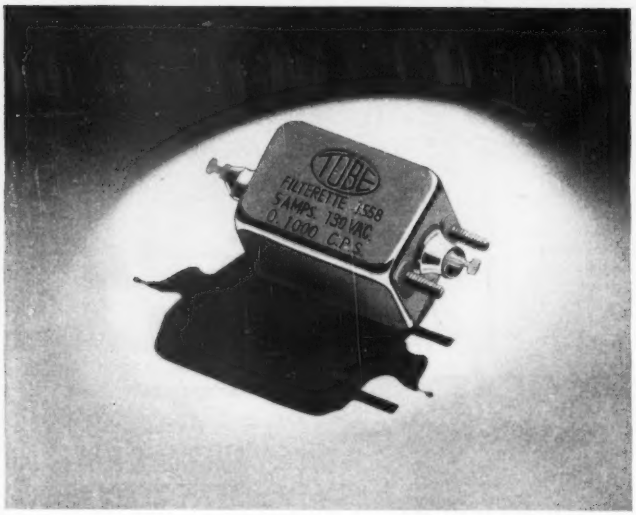
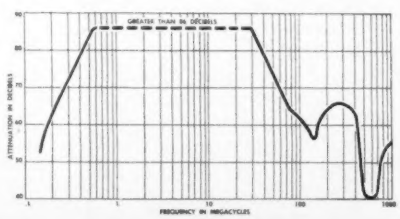
5-ampere Radio Interference Filter



In a space only 1¼ x 1⅛ x 1¾ inches, this new, miniature, radio interference filter provides more than 86 db attenuation from 0.6 to 30 megacycles and handles five amperes at 130 volts, 0-1000 cycles per second, with a voltage drop of only 0.25 volt at full load. This unit is designed for bulkhead mounting, with input and output terminals on opposite sides of the bulkhead. The Type 1558 Miniature Radio Interference Filter is hermetically sealed in a drawn, metal case with glass terminals. It is built to withstand the shock and vibration of aircraft service. Attenuation characteristics are shown on the curve below.

For help with any interference problem, call on Tobe — specialist in filtering since 1929, originator of modern filtering methods.



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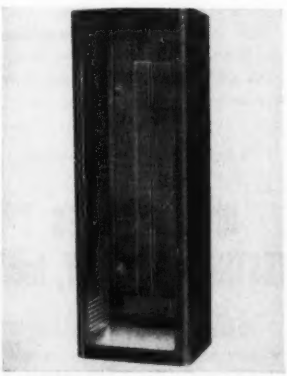
some novel direct-coupled features give stable values of Q up to 100 plus feedback stabilization of gain even at the peak of the frequency response curve. Ask for peaked amplifier bulletin 504.

Mercury Switches

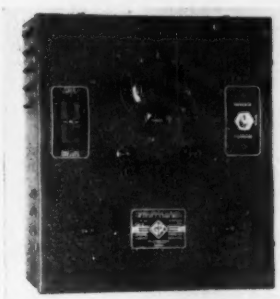
MICRO SWITCH, Freeport, Ill., has announced newly designed Honeywell mercury switches embedded in plastic potting compounds for added protection. The first of these new switch assemblies is the 1MP1 switch whose overall size is 2½ in. long, 3¼ in. wide and 1¼ in. high. This unit provides less than 1 deg differential angle, with an electrical rating of 2 amperes 115 volts a-c, or 1 ampere 115 volts d-c. Contact arrangement is single-pole, normally open.



Relay Racks

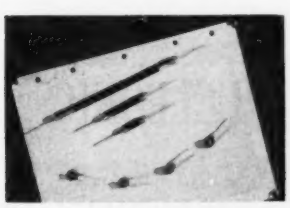
PREMIER METAL PRODUCTS CO., 3160 Webster Ave., Bronx 7, N. Y., announces the manufacture of a line

of enclosed relay racks rigidly constructed of 16 gage cold rolled sheet steel. The panel mounting angles of 12 gage steel are tapped for 10/32 machine screws on Western Electric spacings. Panels fit into a recess so that edges are not exposed. Rear doors are hung on sturdy loose-jointed hinges and closed by a flush snap catch. A complete catalog of precision-built metal housings is available on request.



Motor Speed Control

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Designed for light production work where a ¾ h-p motor is used, the type 1702-A Variac speed control uses no electronic tubes and so takes no warm-up time. Instant starting and reversing are provided together with strong dynamic braking. It saves production time. Typical applications are on lathes, for instance, where several operations are done on the same piece at different optimum speeds; or for operations such as blind tapping where gradual starting and stopping is desired.



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GEPN-2	2.64E2 - 0.4 - 800	50P2T	1 13/16 x 1 1/16 x 2⅝
GEPN-4 14E	{ 2 - 0.5 - 2000; 7 - 0.185 - 380; 9 - 2.35 - 380 }	50P4T	8 x 4 x 4¼
RCPN-2	17E3 - 2.0 - 600	50P2T	3 x 6 x 7
RCPN-4	24E2 - 1.0 - 630	25PY2T	10 x 4½ x 7 9/16
RPN-5	11.5E4 - 2.0 - 400	16P2T	5½ x 10 x 10
SPN-8	6E4 - 0.45 - 2000	50T2T	3⅝ x 2¼ x 4⅝
SPN-14	8E { 2 - 0.25 - 4000; 4 - 0.50 - 2000; 7 - 1.0 - 1000; 12 - 2.0 - 500 }	55P8T	4 x 8 x 2
SYPN-6	2E3 - 1.0 - 5p	50P2T	1 1/16 x 1 13/16 x 3½

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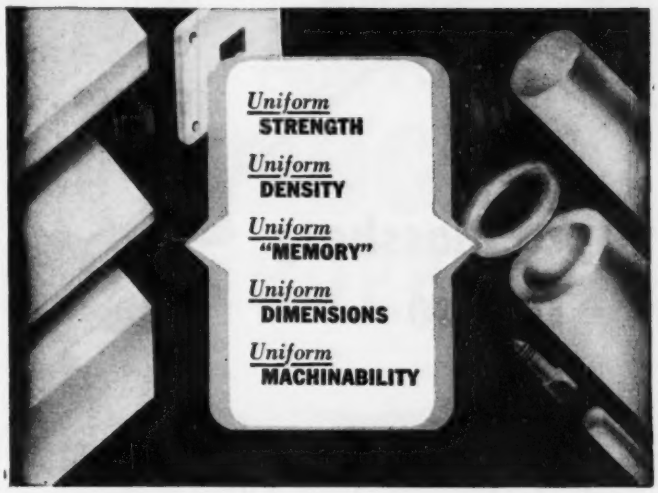

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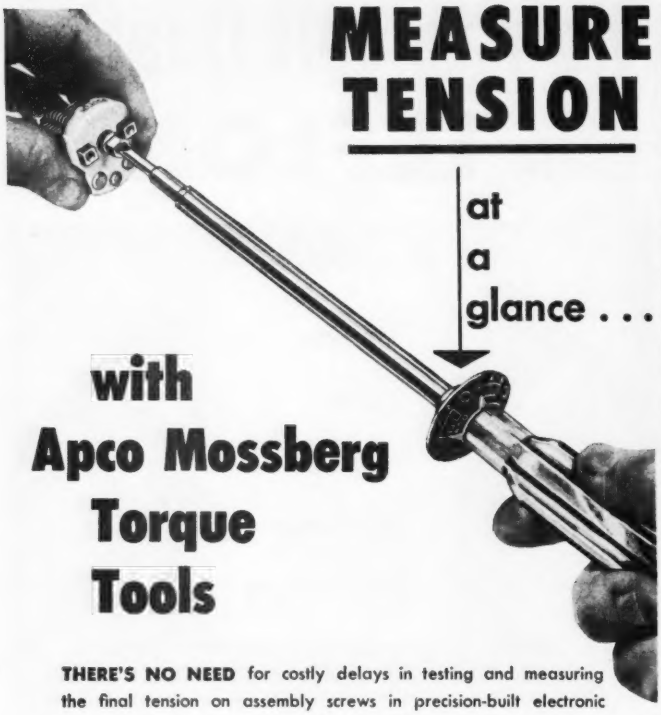

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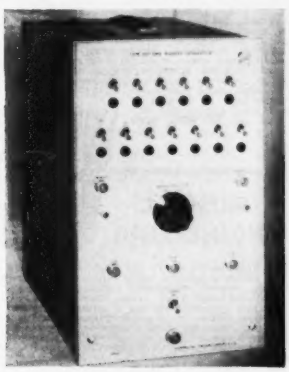

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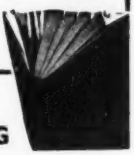
RADIO ANTENNA ENGINEERING

3. Provides guidance in the design and construction of receiving and transmitting antennas used in point to point, ground-to-air, and military communications, as well as broadcasting. Deals with wires, masts, and towers, with frequencies up to 30 mega. Treats radiation, circuital, and mechanical engineering, operational requirements, bandwidth, propagation and system engineering for each type of antenna. Includes advanced designs suggested by very-high frequency and ultra-high-frequency techniques, emphasizing their growing importance. By Edmund A. Laport, Chief Eng'r, RCA Int. Div. 563 pp., 386 illus., $9.00



MUSICAL ENGINEERING

4. Explains the theory and practice of interrelated phases of musical engineering—including speech, music, musical instruments, acoustics, and hearing. Treats the construction, range, characteristics, vibrating and resonating systems of musical instruments. Analyzes each aspect of sound reproducing and pickup systems. Gives help toward better production of vocal and instrumental music, in acoustic design of studios, and problems in recording, transmission, and broadcasting of music and speech. By Harry F. Olson, Dir. Acoustical Laboratory, RCA Laboratories, Princeton, N. J. 309 pp., 303 illus., 28 tables, $6.50

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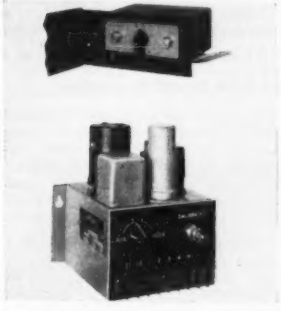
oscilloscope time base calibration and is useful for calibrating counters and computers.

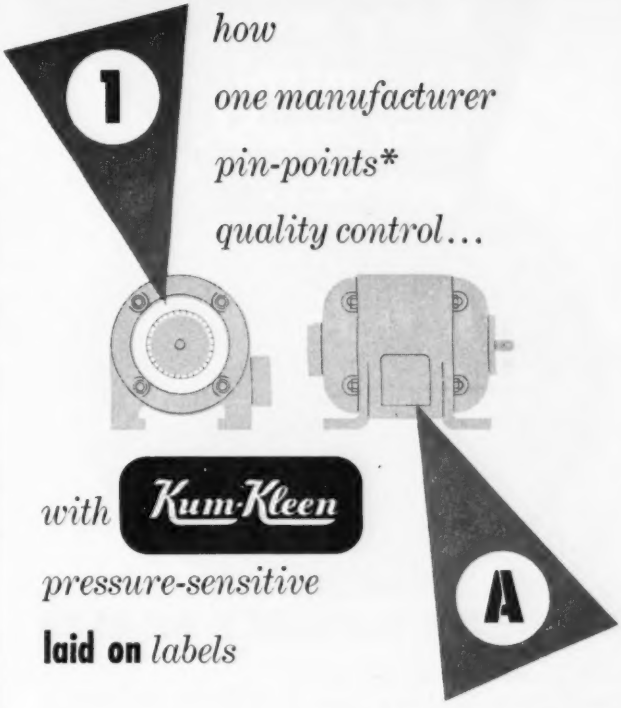
Aircraft Test Instrument

MIDWESTERN GEOPHYSICAL LABORATORY, Tulsa, Oklahoma. Model 310 dynamic meter is a miniature oscillograph used to present flight test data for either visual or photographic observation. The galvanometers used in the meter produce appreciable deflections from conventional strain-gage signals without amplification. The light intensity of the edge-lighted Lucite screen may be varied (external potentiometer) to produce optimum contrast between signal spots and screen graduations. Specifications include: weight—2.3 lb; optical arm distance—4.8 in.; and power required—24 v at 1.5 amperes.



Demodulators

AUTOMATIC TEMPERATURE CONTROL CO., INC., 5200 Pulaski Ave., Philadelphia 44, Pa. Three new demodulators have been designed for rectifying an a-c signal, generated by an Atcotran transmitter for



A PROMINENT MAKER of electric motors *pin-points* quality control by identifying every production and inspection operation with Avery Kum-Kleen self-adhesive labels. It's a simple, easy way to quickly trace and correct any variations from their high standards of quality. Prior to the use of Kum-Kleen labels, which are just LAID ON with a finger-touch, no other method had proved satisfactory.

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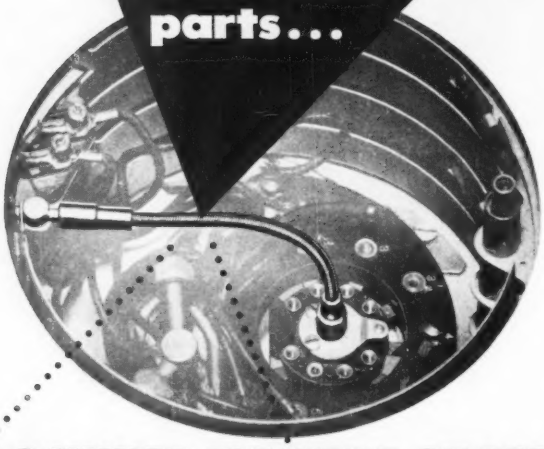

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Providing a means of controlling inaccessible parts *could be* a tough problem — especially if the parts had to be mounted some distance away from the point of control. We say *could be,* because S.S.White remote control flexible shafts are a simple, time-saving way to do the job.

These shafts have been built just for this purpose. They have all the flexibility needed to run them around turns or to install them over or under obstacles. What's more, S.S.White flexible shafts have the necessary physical properties to provide a quality of control that satisfies practically every requirement. It's simply a matter of proper selection and application.

Use them to —

- Meet exacting space and dimensional requirements
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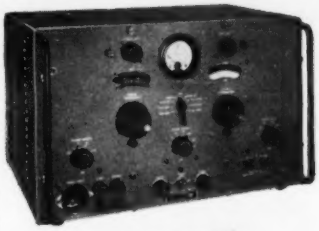

the Type H-12 UHF SIGNAL GENERATOR

900-2100 Megacycles

This compact, self-contained unit, weighing only 43 lbs., provides an accurate source of CW or pulse amplitude-modulated RF. A well-established design, the Type 12 has been in production since 1948. The power level is 0 to —120 dbm, continuously adjustable by a directly calibrated control accurate to ± 2 dbm. The frequency range is controlled by a single dial directly calibrated to ± 1%. Pulse modulation is provided by a self-contained pulse generator with controls for width, delay, and rate; or by synchronization with an external sine wave or pulse generator; or by direct amplification of externally supplied pulses.

Gold Plating of the oscillator cavity and tuning plunger assures smooth action and reliable performance over long periods. Generous use of silicone-treated ceramic insulation, including resistor and capacitor terminal boards, and the use of sealed capacitors, transformers, and chokes, insures operation under conditions of high humidity for long periods.

Built to Navy specifications for research and production testing, the unit is equal to military TS-419/U. It is in production and available for delivery.

Price: $1,950 net, f.o.b. Boonton, N. J.

Type H-14 Signal Generator

(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/150 cps localizer, left-center-right on phase localizer, Omni course sensitivity, operation of TO-FROM meter, operation of flag alarms.

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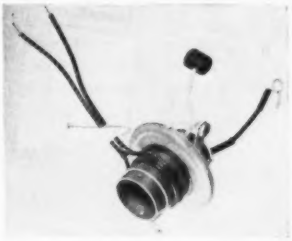
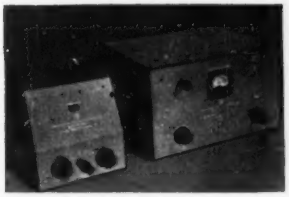
pressure, flow, thickness, weight and displacement, into a d-c signal that may be fed into a d'Arsonval type d-c meter or potentiometer type instrument of the indicating or recording variety. Operation features include a single electronic tube rectifying circuit designed for continuous trouble-free service. One type 6101C will operate into any existing potentiometer type recording instrument and incorporates a chopper circuit for changing the a-c input signal to the d-c output signal.



Autotransformer

RAM ELECTRONICS SALES CO., Irvington-on-Hudson, N. Y. Latest horizontal output transformer just off the company's production line is the model X068 air-core autotransformer. Featuring high efficiency and excellent voltage regulation, as well as improved anticorona construction, it delivers 11 to 13 kv output for 14 to 20-in. tv picture tubes. Since the unit is designed for direct drive circuits, the model Y70F30/3 direct-drive deflection yoke is recommended as its associated component.



Magnetometer

LABORATORY FOR ELECTRONICS, INC., 75 Pitts St., Boston 14, Mass. Model 101 magnetometer accurately measures magnetic field strength by

If you use parts like these (up to ¼" dia. and to 1½" length) in large quantities, it is almost certain that we can show you a big saving. And assure on-time deliveries to meet your pressing defense work schedules. We have something unique back of that claim . . .

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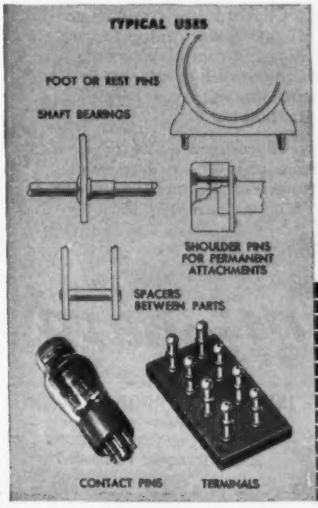

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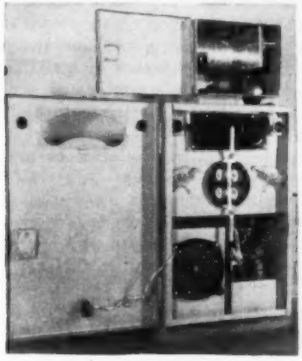
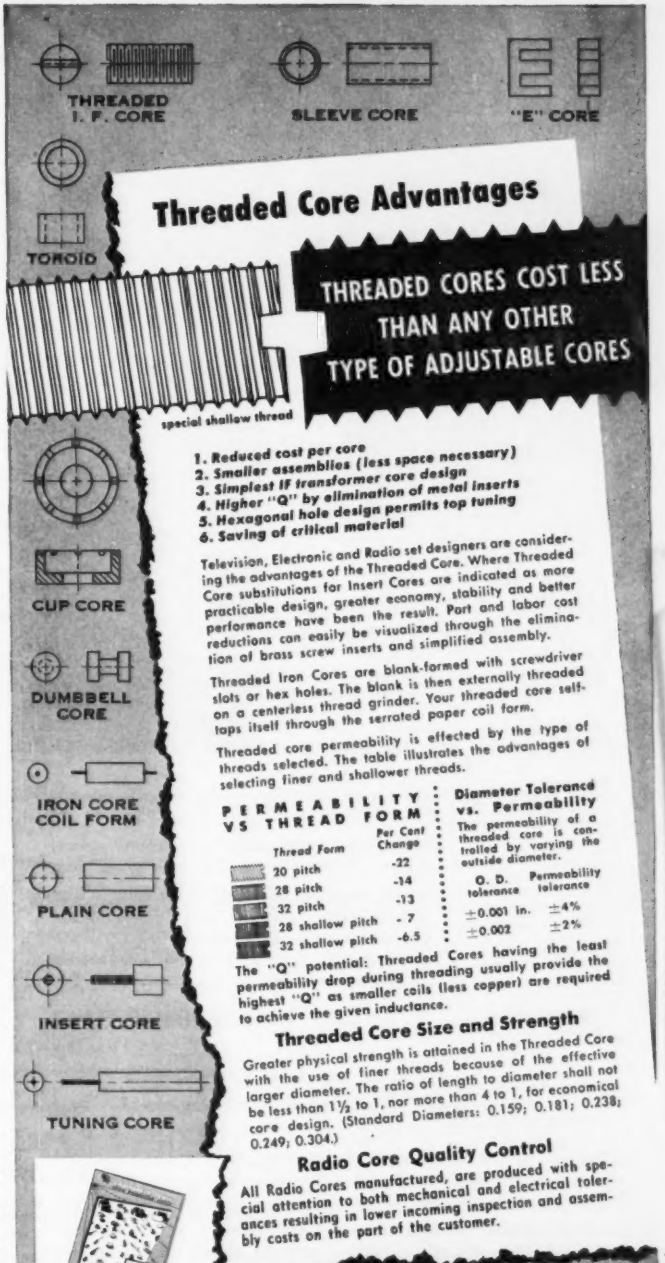


Remote Indicating Contact Gage & Alarm

INDUSTRIAL ELECTRONICS CO., INC., Hanover, Mass., now has a device for measuring thickness on the fly and indicating at a convenient remote location. Any material which can tolerate a moderate pressure, such as rubber or asphalt tile, metals of all kinds, sheet asbestos and rubber impregnated cloth can be measured. The device consists of two sections: (1) a housing containing a precision ground roller mounted with and coupled to a selsyn motor; (2) a main cabinet containing a scale graduated in thousandths of an inch, as well as an electronic relay connected to a selsyn motor in such a way that a pilot light is lit when the material


THREADED I. F. CORE
SLEEVE CORE
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Threaded Core Advantages
THREADED CORES COST LESS THAN ANY OTHER TYPE OF ADJUSTABLE CORES
special shallow thread
1. Reduced cost per core
2. Smaller assemblies (less space necessary)
3. Simplest IF transformer core design
4. Higher "Q" by elimination of metal inserts
5. Hexagonal hole design permits top tuning
6. Saving of critical material
Television, Electronic and Radio set designers are considering the advantages of the Threaded Core. Where Threaded Core substitutions for Insert Cores are indicated as more practicable design, greater economy, stability and better performance have been the result. Part and labor cost reductions can easily be visualized through the elimination of brass screw inserts and simplified assembly.
Threaded Iron Cores are blank-formed with screwdriver slots or hex holes. The blank is then externally threaded on a centerless thread grinder. Your threaded core self-taps itself through the serrated paper coil form.
Threaded core permeability is effected by the type of threads selected. The table illustrates the advantages of selecting finer and shallower threads.
PERMEABILITY VS THREAD FORM
Thread Form
Per Cent Change
20 pitch -22
28 pitch -14
32 pitch -13
28 shallow pitch - 7
32 shallow pitch -6.5
Diameter Tolerance vs. Permeability
The permeability of a threaded core is controlled by varying the outside diameter.
O. D. tolerance
Permeability tolerance
±0.001 in. ±4%
±0.002 ±2%
The "Q" potential: Threaded Cores having the least permeability drop during threading usually provide the highest "Q" as smaller coils (less copper) are required to achieve the given inductance.
Threaded Core Size and Strength
Greater physical strength is attained in the Threaded Core with the use of finer threads because of the effective larger diameter. The ratio of length to diameter shall not be less than 1½ to 1, nor more than 4 to 1, for economical core design. (Standard Diameters: 0.159; 0.181; 0.238; 0.249; 0.304.)
Radio Core Quality Control
All Radio Cores manufactured, are produced with special attention to both mechanical and electrical tolerances resulting in lower incoming inspection and assembly costs on the part of the customer.
CUP CORE
DUMBBELL CORE
IRON CORE COIL FORM
PLAIN CORE
INSERT CORE
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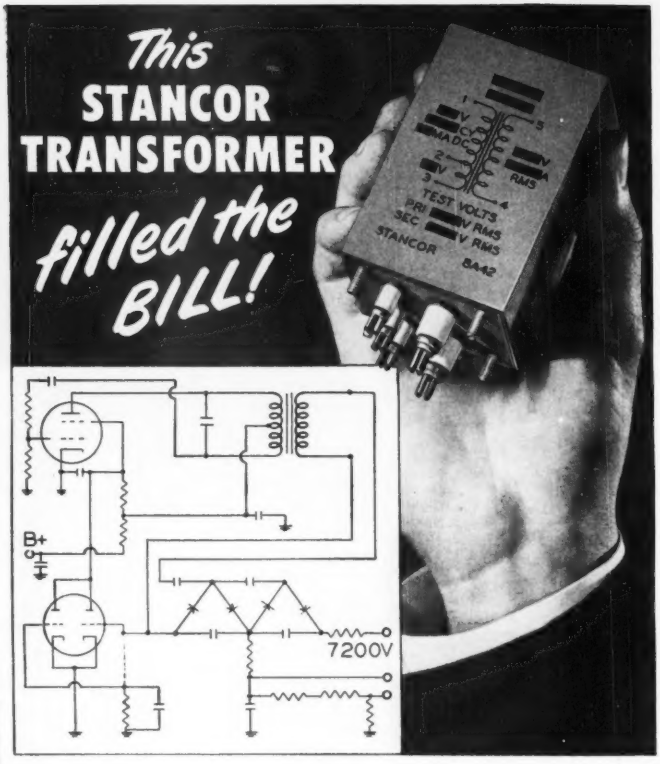

Problem:

- √ To design and build a transformer to operate in an oscillating circuit at 1500 CPS.
- √ Output voltage through a voltage quadrupler is to be 7200V±5% at 20 microamperes load.
- √ Oscillating frequency and output voltage must remain stable from -40°C to 65°C and the unit must meet the requirements of MIL-T-27, grade 1, Class A, specifications for hermetically sealed transformers.

Solution: STANCOR TRANSFORMER 8A42

For the Answer to Your Toughest Problems of Transformer Design, Consult Stancor Engineers!

Stancor welcomes troublesome problems of transformer design, like the one illustrated, as a responsibility of leadership. We have the necessary engineering skill and resources, backed by in-plant facilities for qualification testing of MIL-T-27 transformers. Next time you're faced with a transformer design problem, let our engineers offer you a quick, practical solution.

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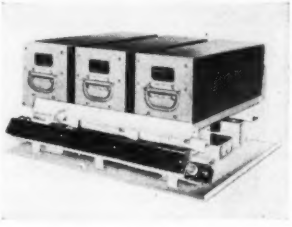
being measured exceeds the preselected tolerance.

Terminal Strips

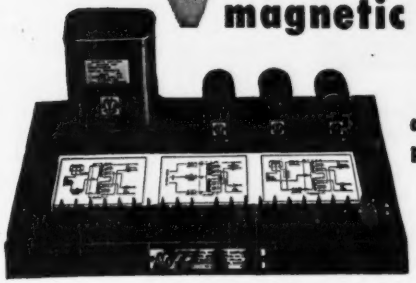
THE BRACH MFG. CORP., 200 Central Ave., Newark, N. J., has developed the type 2500 universal terminal strips (shown above, rear). Each is made of 10 units molded in one piece. It is so constructed that circuits can be opened and closed for testing by means of a sliding link without disturbing any connected wire. The strips are made of Bakelite with heavy screws molded rigidly into place to prevent their turning. Type 1500 terminal strip, also illustrated, is smaller and more compact, and uses silicon bronze screws with heavy specially designed nuts for strength.



Railroad & Mobile Equipment

BENDIX RADIO DIV. OF BENDIX AVIATION CORP., Baltimore 4, Md., has announced production of a line of railroad and mobile equipment designed for operation in the 152 to 174-mc band. The new vhf equipment can be packaged either in a three unit housing or a single compact case. The equipment is provided with a choice of transmitter

VICKERS educational magnetic amplifier



Permits study of all three basic single phase self-saturating circuits

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- Gives d-c or a-c output . . . uses d-c or a-c control power.

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Wherever less weight and smaller size are vital, these sub-miniature and miniature meters allow more savings. They not only provide accuracy and dependability equal to that of larger models, but, in addition, the inherently strong construction withstands shock and vibration far better than conventional sized instruments. A D'Arsonval type movement of excellent design, precision workmanship and materials of selected quality permit miniaturization while retaining high performance standards.

Meters, testing devices and allied equipment are available for a wide variety of requirements and can be adapted for use wherever it is desired to measure quantities electrically. Instruments are engineered for unusual applications by our staff of skilled technicians. Efficient production insures good delivery and low cost on both regular and special jobs.

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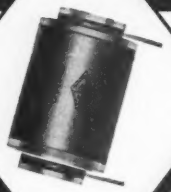
TYPE B-13 — PRECISION WIRE-WOUND RESISTORS

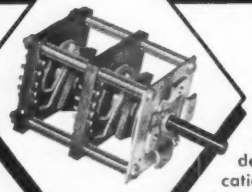


NON-INDUCTIVE: Accuracies 1% to 1/20%. ¼ to 10 Watt power ratings. Several impregnation treatments to fit your specific requirements. 42 different styles. Sub-miniature and laboratory instrument types. Characteristics to best commercial tolerances; temperature coefficients; and wire alloys. Orders accepted for special controlled, calibrated resistors, and ratio sets. Cinema resistors are finding nation-wide acceptance from proto-type to production. For complete technical data, write for Catalogue 14-R.

TYPE 992-A — PRECISION VARIABLE ATTENUATORS

ROTARY TAP CONTROLS: Precision and general purpose types. Resistance accuracies 5% to 1/20%. Nickel silver contacts and brushes. Low, constant contact resistance with stutter-free performance. "Multi-brush" design assures positive wiping action and quiet operation. Fine decibel accuracy and accurate voltage ratios. Mixer and detented action. Special ratio and resistance steps. (Specials are our largest business.) Write for Catalogue 18-A.

TYPE CES — INSTRUMENT SWITCHES



ROTARY TAP TYPE: Low contact resistance and long life are features of the CES design. Complete with integral detent action with stops or 360 degree rotation. Nickel silver contacts and brushes. Phenolic insulation. Especially designed for dc and audio instrument applications. Custom built in jig-time from basic production parts. Speedy service is the key-note of this design. Catalogue provides formula by which literally hundreds of switch circuit possibilities may be selected to fit your specific needs. Request Catalogue 17-S.

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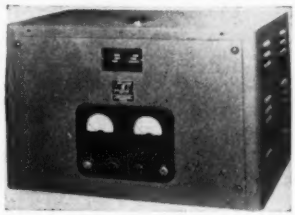
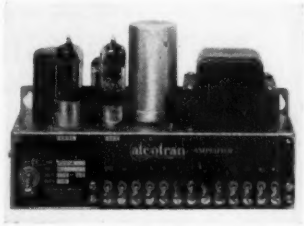
Export Agents: Frazar & Hansen, Ltd. • 301 Clay St. • San Francisco, Calif., U.S.A.

power—2½, 12, 25 or 35 watts. In addition, fixed stations can transmit up to 60 watts. The transmitter consists of basic exciter chassis with interchangeable power amplifier decks which, when operated with appropriate power supply, can be replaced at any time to increase power as desired. Dual channel operation can be provided by insertion of sealed plug-in relay and crystal. Frequency stability is 0.0006 percent with crystal type oven and 0.0025 percent without oven.



Low-Voltage High-Current D-C Sources

SORENSEN & Co., INC., 375 Fairfield Ave., Stamford, Conn., has available an addition to its line of Nobatrons. Designated as models E-6-5A, E-6-15A, E-6-40A and E-6-100A Nobatrons, the instruments convert nominal 115 v ac line to 6 v d-c adjustable ±10 percent, at currents of 5, 15, 40 and 100 amperes respectively, and with a regulation accuracy of ±0.2 percent. The important new feature is a front panel switch that instantly changes output from 6 v d-c to 7 v d-c, adjustable ±10 percent.



Servo Amplifier

AUTOMATIC TEMPERATURE CONTROL CO., INC., 5200 Pulaski Ave., Phil-

Production capacity has recently been expanded to supply your increasing demand for vibrators and vibrator power supplies. Engineering facilities are available for designing vibrators and power supplies to your specifications.

Victoreen has two standard vibrator power supplies for use with battery-operated portable equipment such as Geiger counters, photo-multipliers, and electronic equipment requiring a high voltage supply. These compact units have been potted and hermetically sealed to make them reliable and rugged. They contain regulator circuits to stabilize their outputs. Net weight is only one pound.

- THE MODEL 517 VIBRATOR POWER SUPPLY operates from 4.5 volts dc and supplies +900 volts at 5 microamperes and +58 volts at 0.25 milliamperes.
- THE MODEL 532 VIBRATOR POWER SUPPLY operates from 3.0 volts dc and supplies −900 volts at 15 microamperes and +58 volts at 0.25 milliamperes.

The precision vibrators which are used in these power supplies are available separately. They have been mounted in sponge rubber and hermetically sealed, and are invaluable for such applications as high voltage power supplies, portable Geiger counters, scintillation counters, and portable radios. These plug-in units weigh only 2½ ounces.

- THE MODEL 531 VIBRATOR is designed to operate from a 1.5 or 1.3 volt battery and requires as little as 18 milliwatts driving power.
- THE MODEL 532 VIBRATOR is also an 18 milliwatt unit, but designed for operation in series with the primary of a transformer and from a 1.5 to 6 volt battery.

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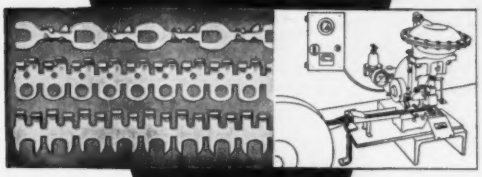

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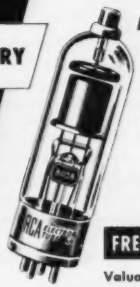

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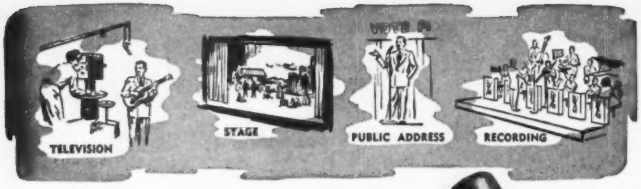

It's New!

The TURNER 51D

The new Turner Model 51D (similar to the Model 50 Aristocrat) offers exceptionally high quality performance at a new low cost. The Model 51D is essentially non-directional in operation — equally effective for individual or group pickups. A unique ball swivel coupler permits fast change from stand to hand or vice versa.

Use the Model 51D anywhere, indoors or out — it's blast-proof, and not affected by variations in humidity or temperature. Advanced circuit design with high output dynamic generator requires no closely associated auxiliary equipment for outstanding results.

For TV, FM, AM, recording and public address specify the Turner Model 51D — the outstanding dynamic microphone in its field.

SPECIFICATIONS

Frequency Response: 60 to 13,000 c.p.s. substantially flat.
Output Level: 58 db below 1 volt/dyne/sq. cm. at high impedance.
Impedance: Choice of 50, 200 or 500 ohms connected for balanced line output; high impedance (25,000 ohms) connected for single ended output.
Polar Pattern: Essentially non-directional in any position.
Transformer: Magnetically shielded for minimum hum pickup.
Diaphragm: Special aluminum alloy.
Case: All metal rich umber grey finish.
Mounting: Ball and swivel type, tilts in any direction. Standard 5/8" — 27 thread.
Dimensions: 1 5/8" maximum diameter, 6½" long (less cable connector).
Weight: 16 oz. (less cable).
Cable: 12 foot high quality two conductor shielded cable with Cannon quick-disconnect plug.
List Price: $85.00.

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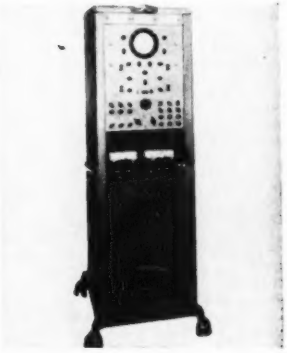
EXPORT
Ad. Auriema, Inc.
89 Broad Street, New York 4

adelphia 44, Pa., has introduced a high-gain, class A amplifier that is designed for driving servo-mechanisms from very small a-c input potentials such as those generated by differential transformers, a-c potentiometer circuits and resistive and inductive bridge circuits. The amplifier consists of a low-impedance transformer input to a dual triode, two-stage voltage amplifier tube which drives a pentode power amplifier tube having one motor winding in its anode circuit. The d-c voltage for the amplifier is obtained from a transformer and a full-wave rectifier tube. A potentiometer in the grid of the pentode provides control of the amplifier gain. Power input to the unit is isolated from ground allowing the input circuit to be adequately grounded and decrease the possibility of stray pickup.



Memoscope

MILLIVAC INSTRUMENT CORP., 444 Second St., Schenectady 6, N. Y. Type MS-10A Memoscope records magnetically wave shapes and signal traces for instantaneous reproduction on the screen of its c-r tube. A new frequency converter makes it possible to record magnetically frequencies as high as 10 mc without harmonic distortion. The instrument can be used as a production testing tool where instantaneous comparison of wave shapes is needed, also as an auxiliary device in development and research where wave shapes change too frequently for photographic reproduction and

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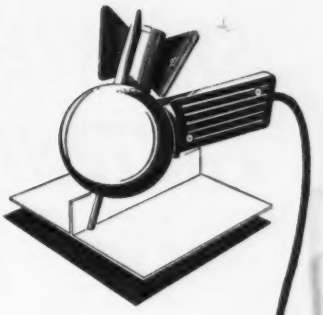

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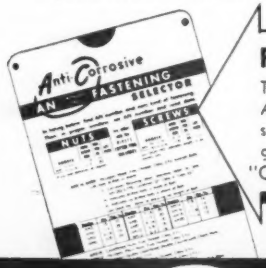

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FEDERAL TELECOMMUNICATION LABORATORIES, INC., Nutley, N. J., has announced a new low-cost utility picture monitor for tv station applications. The FTL-P-91B monitor is available either rack or cabinet mounted. A high-quality, high-resolution 9 × 12-in. presentation is made on a 16GP4 kinescope. Duplicate coax input connectors with a switch to select composite video, or separate video and composite sync, are provided at the rear of the chassis. A self-contained, fused power supply is included.

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TAPEMASTER, INC., 13 West Hubbard St., Chicago 10, Ill. Model SA-13 portable power amplifier and speaker combines in one unit a new 7½-in. accordion-type floating cone speaker, new advanced amplifier design, and a more effective principle of baffling. Amplifier response is within 1 db from 30 to 15,000 cps. Total distortion at 5-w output

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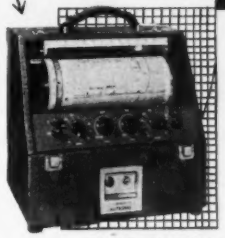

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SPECIFICATIONS: —Two independent servo-actuated recording axes: input free of ground. • Recording speed, both axes, 1 second for full scale travel. • Scales: from 0-5 millivolts up to 0-100 volts, both axes. • Full-range zero set on either axis—plots data in any desired quadrant. • Sensitivity—200,000 ohms per volt, 5 microamperes drain for full scale. • Size and weight: 13" x 13" x 10"; 35 lbs. • Self-contained; operates from 115 volt 60 cycle line, 85 watts.

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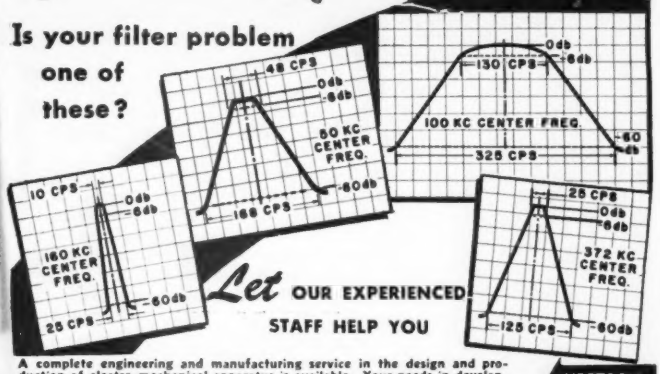

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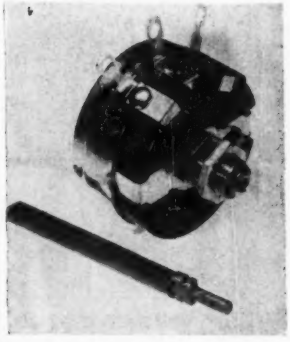

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CLAROSTAT MFG. CO., INC., Dover, N. H., announces availability of wire-wound controls with field-attached shafts. The new controls may be used with any one of the company's 11 different Pick-A-Shafts. They come in three series: the A43 is rated at 2 watts; the A58 is rated at 3 watts; and the A10 is rated at 4 watts. A wide range of resistance values is available in each series.

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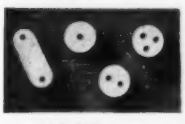

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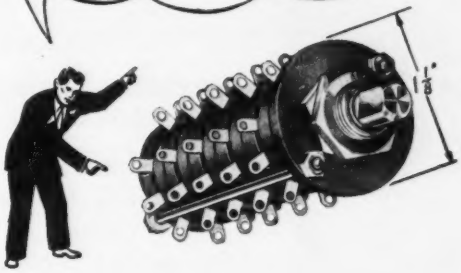

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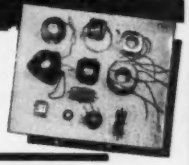

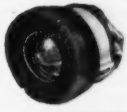

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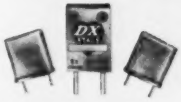

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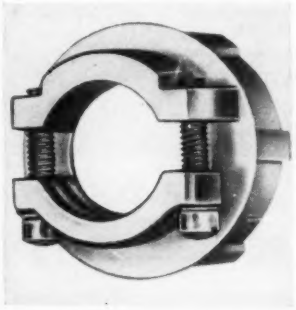
be easily and accurately accomplished on any real-time analog computer such as IDA, REAC or GEDA. Generation of these three nonlinear functions is made possible by a new, compact unit, designated model NLU-2. It has two completely independent channels, each of which may be set for any of the three modes of operation. All-electronic in design, the unit may be used at higher frequencies than a servo- operated function generator. The NLU-2 has a self-contained power supply operating from a 115-v, 60-cycle line and drawing ½ ampere.



Cable Clamps

TLG ELECTRIC CORP., 31 W. 27th St., New York 1, N. Y., are producing AN3057 cable clamps in 7 popular sizes. These clamps are time-proved standards for communication application in the electronics, aviation, marine, railroad and transportation industries. Precision-manufactured and guaranteed to meet every requirement of rigid Army-Navy specifications, these clamps support cable or wire at the plug or receptacle with excellent security, and prevent twisting or pulling at vulnerable soldered connections. The sizes of type AN3057 now in production are: 3, 4, 6, 8, 10, 12 and 16. Further information is available on request.

Phono Accessories

GENERAL ELECTRIC CO., Syracuse, N. Y., has added a new variable reluctance cartridge and a new wide-

IT'S NEW!

10-POUND PORTABLE BATTERY-OPERATED TAPE RECORDER

THE **MAGNEMITE***

***NEW* DRY BATTERIES**

Inexpensive flashlight-type cells that last 100 operating hours.

***NEW* SPRING MOTOR**

Governor-controlled constant speed motor runs 15 minutes per winding.

***NEW* PLAYBACK & MONITORING**

Feeds directly into headphones or external amplifier and speaker.

***NEW* SENSITIVITY**

Crystal-clear recordings up to 100 feet from the microphone.

4 models available
Priced from $225
Size: 11½ x 8½ x 5½

Field recording is now as easy as studio recording, with the Magnemite* Portable series. There's a midget battery-powered spring-motor Magnemite* model for every recording need — speech, music and sound effects. Write today for descriptive literature and direct factory prices.

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398 Broadway New York 13, N. Y.

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- Sealing
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- Cementing
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Transformers
Condensers
Rectifiers
Sockets
Switches
Wiring Devices

Robinson Metering Pump being used to forcibly eject metered amounts of cement into wire brush handle. Reservoir temperature 350° F.

Not a gravity dispenser — Forcibly ejects hot waxes and cements.
Thermostatically controlled heat — Variable with a maximum reservoir temperature of 450° F.
Motor driven, clutch actuated — 2/3 second per ejection.
Variable discharge — Ejections changed in 2 seconds, *without tools.*
Reduces unit costs—No skilled operator required. Saves material — reduces rejects.
Easily installed — Adaptable to any production set-up.

For complete information on this modern production tool and its possible application to your requirements, write for Bulletin No. 1A-R.

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Ideal for
ANTENNA CONNECTIONS
PHOTO-CELL WORK
MICROPHONE CONNECTIONS

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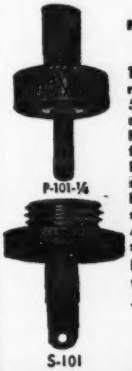
SHIELDED TYPE
PLUGS & SOCKETS



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101 Series can be furnished with ¼", .290", 5/16", ⅜" or ½" ferrule for cable entrance. Knurled nut securely fastens unit together. Plugs have ceramic insulation and sockets have bakelite. Quality construction. Fine finish. Assembly meets Navy specifications.

For full details and engineering data ask for Jones Catalog No. CS-18.

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Detailed construction manual shows clearly where each wire and part goes and tells exactly how to build the kit. Write for free catalog.

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introductory offer

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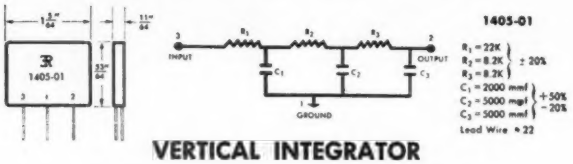
PRINTED CIRCUIT KITS



VERTICAL INTEGRATOR

Printed Electronic Circuits offer so many advantages and savings in space, time and cost that the electronics industry finds new uses for them daily. They are important components in computers, control circuits, military equipment requiring sub-miniaturization, radio and TV sets, hearing aids, remote control model equipment, etc.

Find out for yourself how these Erie Printed Circuits can be valuable to you. Take advantage of Arrow's special introductory offer. Get one, or several, of these special money-saving kits of the entire series for all purposes. Circuit diagram and suggested uses with each unit. Complete technical data supplied on request.

EXPERIMENTER'S KIT

KIT #1
List $11.50

Contains one each of the listing shown below. Ideal for the experimenter, technician, serviceman or hobbyist. Sizes range from 37/64" x 21/64" to 1 11/32" x 57/64": All 11/64" thick with 2½" tinned leads. In handsome plastic case useful for small hardware, etc.

ARROW SPECIAL **5.95**

INTERMEDIATE KIT

Contains six 1405-01, four 1403-01, three each of 1406-01, 1404-01, 1404-02, 1408-01, two each of 1403-02, 1403-03, 1406-02, 1407-01, 1407-02, 1407-03, 1408-02. In Plastic Case.

KIT #2. List $28.50

ARROW SPECIAL **15.95**

NUMBER	DESCRIPTION	LIST PRICE
1403-01	Diode Filter	$.60
1403-02	Diode Filter	.60
1403-03	Diode Filter	.60
1406-01	Triode Plate Coupler	.70
1406-02	Triode Plate Coupler	.70
1404-01	Triode Plate Coupler	.75
1404-02	Triode Plate Coupler	.75
1407-01	Pentode Plate Coupler	.90
1407-02	Pentode Plate Coupler	1.00
1407-03	Pentode Plate Coupler	.90
1405-01	Vertical Integrator	1.10
1408-01	Audio Output Coupler	1.00
1408-02	Audio Output Coupler	1.15

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KIT #3
List $37.00

Offers an extra saving for industry, laboratory, school, research use. Contains DOUBLE the amount of all units listed in Intermediate Kit at left. In Plastic Case.

ARROW SPECIAL **29.95**

For your copy of ARROW'S new 1952-53 1100-page Master Catalog please write Dept. E-10 on your company letterhead.

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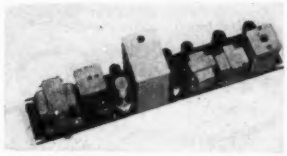
Teletype NY1-472 · Western Union ARROW ELECTRONICS—WUX-N. Y.

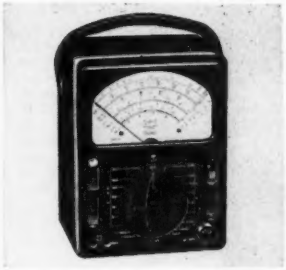
Cable AROLECTRO-N. Y.

range stylus to its line of phono accessories. The new wide cartridge, model RPX-052 is equipped with a dual wide-range sapphire and diamond Baton stylus. It is designed to perform with uniform velocity response up to 15,000 kc. Minimum record wear is assured by designing the stylus in such a way that only six to eight grams of pressure results for all types of records.



Duplex Signaling Unit

HAMMARLUND MFG. CO., INC., 460 W. 34th St., New York 1, N. Y., has introduced a new duplex signaling unit consisting of a tone transmitter and frequency selective receiver designed to operate over wire lines, telephone or power line carrier, and radio or microwave communications circuits. The units may be used to transmit and receive signaling, dialing, telemetering, teleprinting, supervisory controls or other information. Transmitters and receivers are available on the same or different frequencies between 2,000 and 6,025 cps. Up to 33 channels can be used over a single circuit.

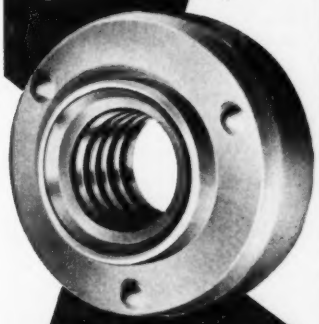


VTVM

TRIPLETT ELECTRICAL INSTRUMENT CO., Bluffton, Ohio. Peak-to-peak a-c voltage and r-f measurements by the model 650 vtvm are made

PEM WELD FASTENERS

Cut Costs



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NO BURN OUTS in thin sheets. Engineered projections prevent.

NO RETAPPING. Shank protects threads from weld spatter.

NO PILOTS or costly special electrodes.

NO INDEXING. Round, compact shape eliminates orientation. Permits use on narrower flanges. Self Locating.

YES. PEM WELD FASTENERS will do a better fastening job at lower cost, wherever load carrying threads are required in thin metals that may be welded. Write for literature and samples for trial. Penn Engineering & Manufacturing Corp., Doylestown, Pa.

PEM

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ACCURATELY MEASURES

Rate of Acceleration or Motion

UP TO 20,000 PER SECOND *WITHOUT* CONTACT

other uses
Measure acceleration and velocity. Trigger or synchronize cathode ray oscillograph sweep circuits, angular position indicator (shaft or fly-wheel), reference marker (degrees, position or dead center), indicate RPM, operations, cycles or motion at rates in excess of 20,000 per second when used with electronic counters.

Model 3010 U. S. Pat. 2396783

NEW Electro ELECTRONIC EQUIPMENT IMPULSE GENERATOR

Small low cost electromagnetic pick-up amplifies electrical impulses for counting recurring operations, revolutions, sequences, cycles or motions. It produces a voltage output proportional to the object's rate of speed. And may be actuated by the displacement or vibration of any magnetic material in the field of the pick-up. Such as a slot or keyway in the rim of a wheel or shaft, the teeth in a gear or any magnetic part on a moving body. *Consult Our Engineers on Your Particular Problem.*

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ELECTRO PRODUCTS LABORATORIES

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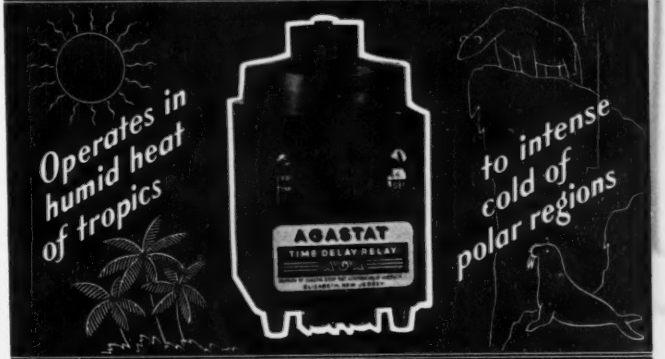

Small – Compact – Few moving parts – Easily mounted
Operates in any position
Time delay range, 1 second to 5 or more minutes

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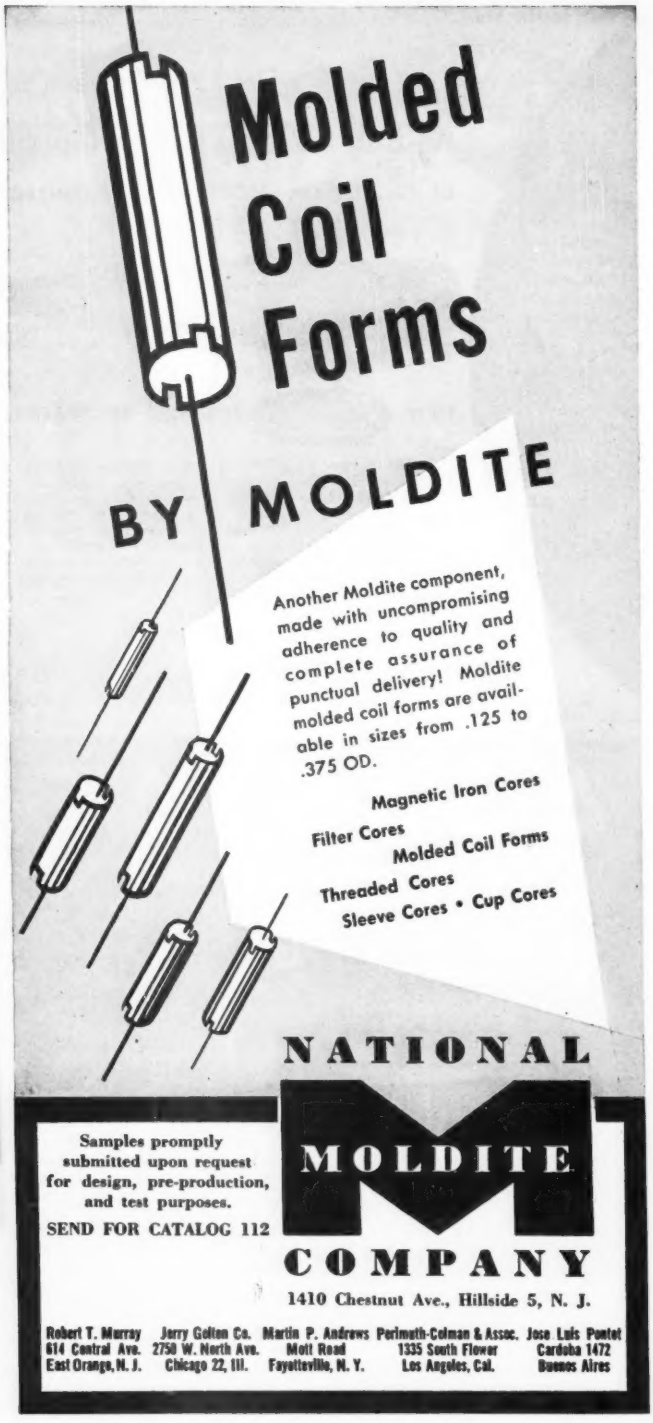
1027 NEWARK AVENUE • ELIZABETH 3 • NEW JERSEY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BY MOLDITE
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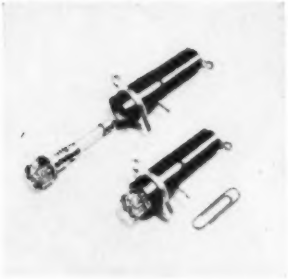
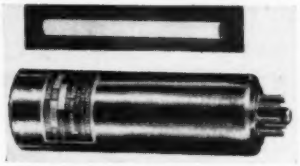
with one probe. Complete frequency coverage is from 20 cps to over 110 mc. One main selector switch controls all ranges. An especially designed, insulated, shielded r-f probe with short leads provides for h-f measurements and the tester has zero center mark for f-m discriminator alignment plus any other galvanometer measurements. A high input impedance of 11 megohms on d-c allows for accurate measurements without loading the circuit under test.



Indicating Fuseholder

ALDEN PRODUCTS CO., 117 N. Main St., Brockton 64, Mass., has announced a new neon indicating fuseholder, the Fuselite 44-5FH, that takes a standard 3AG or 3AB fuse. A unique feature is the integrally molded neon bulb in a crystal clear plastic lens that lights up instantly when the fuse blows. Because of its standard design and compact construction, the 440-5FH has practically universal application in 110 v circuits. With slight modifications it can be used for 220 v.



Frequency Standard

AMERICAN TIME PRODUCTS, INC., 580 Fifth Ave., New York 36, N. Y. Type 2003 frequency standard, a hermetically-sealed, plug-in unit, contains a miniature, high-Q tuning

A NEW HIGH

IN AUDIO WAVE FORM ANALYSIS

PANORAMIC SONIC ANALYZER LP-1

Specifically designed for applications demanding maximum resolution, the LP-1 offers many new possibilities and high speed analysis of sounds, vibrations and electrical wave forms.

4 Selectable Scanning Ranges

Log Scan 40 cps to 20,000 cps

3 Linear Scanning Ranges	Resolution
100 cps	26 cps
500 cps	53 cps
1500 cps	105 cps

• Graphic presentation of frequency vs voltage • Selection and magnification of any spectrum segment for sharp, detailed analysis • Automatic maximum resolution on all scanning ranges • Continuously variable tuning control from 40cps to 20 KC • One cycle per second scanning rate • Wide input voltage range of 500M.V to 500V • Sweep oscillator output connection for operation with Panoramic Sonic Response Indicator G-2

SPECIAL APPLICATIONS

• Investigations of closely spaced sound and vibration frequencies • Harmonic analysis of waveforms having low frequency fundamentals • Spectrum analysis requiring constant band width

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FOR DEPENDABLE PRODUCT WIRING USE

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Year after year — for over ten years — UNILECTRIC has produced millions of wiring systems, for more than 150 leading manufacturers of electric and electronic products. From controls to complex armed forces equipment, these wiring systems have consistently met the most exacting requirements and provided substantial savings to each customer.

To assure utmost dependability plus cost saving engineering assistance, low cost production and "on-schedule delivery" investigate UNILECTRIC today.

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Type SM-15 and SM-30 Resistors offer three vital advantages — sub-miniature size, weather resistant construction and high resistance. The elimination of center hole mounting and the inclusion of axial leads increases winding area and results in 25% greater resistance value than resistors of standard design. Special coating is moisture and fungus proof and designed to meet JAN-R-93 specifications. Sealed in Bakelite construction affords additional climatic protection. As ratings are conservative, types SM-15 and SM-30 can be specified with confidence for service under rigorous conditions.

TYPE SM-15
5/16" DIA. x ⅜" LG.

TYPE SM-30
5/16" DIA. x ¾" LG.

ASK FOR THE NEW RESISTOR HANDBOOK —
Contains complete data on resistors for every purpose and their recommended applications. Please make request on company letterhead.

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fork and all critical circuit components. External circuit consists of one 12AT7, (choice of 5 other types) and 6 small components. Input is 75 to 300 v at 1 to 5 ma, 6 v a-c or d-c at 0.3 ampere. Output frequency is 400 or 500 cycles. Accuracy is ± 1 part in 50,000 at room range, ± 1 part in 5,000 from − 65 to + 85 C. The unit will withstand 125 C ambient temperature. Output voltage is approximately 5 v into 200,000 or more ohms. It has internal silicone shock mounting, and weight is 10 oz maximum. Size is 4½ in. long by 1⅛ in. diameter.

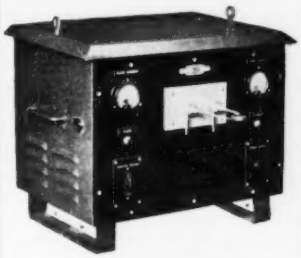
Transcription Player

AUDIO-MASTER CORP., 341 Madison Ave., New York 17, N. Y., has developed a more elaborate version of its transcription player combined with p-a system. Model AM53-PA has a 12-in. detachable loudspeaker with 10-ft extension cord and plays all sizes and types of records and transcriptions from 7 to 17½ in. It has a 5-tube high-gain amplifier, twist crystal cartridge fitted with 2 permanent needles, a 3-speed motor for 33⅓, 45 and 78 rpm, variable volume and tone control, and special mixer that permits simultaneous use of record and microphone.

Literature

Electronic Components. Sylvania Electric Products Inc., Second Ave., Warren, Pa., has issued an 8-page folder illustrating and describing a line of electronic components. Items covered include radio and c-r tube sockets, terminal

2 KW VACUUM TUBE BOMBARDER OR INDUCTION HEATING UNIT



For only $650.

Never before a value like this new 2-KW bench model "Bombarder" or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations.

Simple . . . Easy to Operate . . . Economical Standardization of Unit Makes This New Low Price Possible.

This compact induction heater saves space, yet performs with high efficiency. Operates from 220-volt line. Complete with foot switch and one heating coil made to customer's requirements. Send samples of work wanted. We will advise time cycle required for your particular job. Cost, complete, only $650. Immediate delivery from stock.

Scientific Electric Electronic Heaters are made in the following ranges of Power: 1-2-3½-5-7½-10-12½-15 - 18 - 25-40-60-80-100-250KW.

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"S" CORRUGATED QUENCHED GAP CO.

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PRECISION MACHINES

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See the Complete line

BOOTH 630

National Metals Exposition
October 20-24
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BENDERS
5 hand models
2 power models

SHEARS
4 hand models
4 power models

ROD PARTERS
2 hand models
1 power model

PUNCH PRESSES
2 hand models
2 power models

NOTCHERS
1 hand model
1 power model

BRAKES
10 hand models

ROLLERS
2 hand models

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for your Specialized Needs

DRY TYPES
78 Standard Industrial, Laboratory and Government Types.

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Our engineers will design and create to your requirements. Send us your specifications.

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Water activated "One Shot" Batteries.

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Components

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VELVET VERNIER MECHANISMS

National's famous line of velvet vernier mechanisms has been accepted by well-known commercial users as well as individual builders. Having a standard 5 to 1 ratio, they are available to fit either 3/16" or 1/4" shafts. Types are also available with insulated or non-insulated output hubs for connecting to 1/4" output shafts. Write for drawings and specifications.

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National terminal assemblies have proved extremely popular because of extremely low-loss characteristics, their rugged construction and practical design.

Type FWG is a Victron terminal strip for high frequency use. Binding posts take banana plugs at top, grip wires through a hole at bottom.

Type FWH — the insulators of this terminal assembly are moulded bakelite. Binding posts same as FWG.

Type FWJ utilizes same insulators as FWH, but has jacks.

FWG

FWH

FWJ

Write for drawings

National
NC
EST. 1914
NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

boards, terminal strips, plugs and connectors and loop antennas.

Ultrasonic Soldering Equipment. Mullard Ltd., Century House, Shaftesbury Ave., London, WC2, England. An 8-page publication describes the principles and methods of use of the company's ultrasonic soldering equipment, which consists of a soldering iron and tinning bath. Applications suggested for the equipment include the tinning of electronic chassis assemblies, the soldering of connections to aluminum foil capacitors, and the joining of aluminum lugs to stranded aluminum cables.

Self-Locking Fastener. Elastic Stop Nut Corp., 2330 Vauxhall Road, Union, N. J. Interesting case histories and latest engineering data for the Rollpin self-locking fastener are important features of catalog No. 800. Photographs illustrate the versatility of the device as a practical substitute for rivets, cotter pins, set screws, stop pins, hinge pins, positioning dowels, lock pins and shaft keys.

Precision Indicating Potentiometers. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. Specification sheet 177 describes and illustrates both the new console type operator's desk and the Brown ElectroniK precision indicator. It describes the precision indicator for both single and multipoint indication of variables as well as the extended range indicator and shows how this indicator, when combined with the operators desk and banks of switches, permits the operator to review and log many variable readings while sitting at the desk.

Potentiometers and Resistors. Cornell Electronics Corp., 40-33 Main Ave., Douglaston, N. Y. A recent 4-page folder gives a technical description and illustration of the F-101 series potentiometers designed for military airborne instrumentation and similar applications. Also included is information on the company's standard

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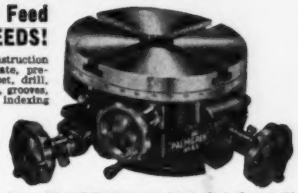
The Only Table Having Rotary Feed Combined with DUAL CROSS FEEDS!



This PALMGREN TABLE is sensational in price, construction and performance. Just what shops need for accurate, precision work. You can rout straight or curved, rabbet, drill, sand or mortise. Do hundreds of jobs as milling slots, grooves, keyways, squares, hexagons, curves, flats, dovetails, indexing and laying out work.

Designed for use on Drill Press or Milling Machine. It handles all types of metal and woodworking operations and makes your drill press a vertical milling machine. Precision built, it permits close tolerances. Rotary Feed is calibrated in degrees. Cross Feeds in thousandths. Cross slides and feeds are 2½" each side of center—4½" overall. Adjustable gibs on cross slides—4 to 1 worm and gear ratio in rotary feed. 4 Bolt slots—2 lock screws.

No. 83 ROTARY TABLE Only $54.50

No.	BASE KEYWAY	T-Slots	TABLE DIA.	BASE DIA.	HEIGHT	WEIGHT	PRICE
83	5/8"	5/8"	8"	6 1/4"	5"	28 lb.	$54.50
82	Same as above without Rotary Feed					26 1/2 lbs.	$43.75

QUICK, ACCURATE Setups—End Delays—Spoilage with this Angle Vise

only $8.75 "M" Base $3.00

Solve all your difficult angle jobs! End make shift methods, delays and spoilage with this famous PALMGREN ANGLE VISE. Ideal for Drilling, Milling, Grinding, Filing, Fitting, Marking and hundreds of jobs requiring speed and accuracy of angles on machine or bench. Set at any angle up to 90 degrees and lock—it's ready for use. Accurately graduated, every part of vise is accurately machined. Jaws of steel 2¼" wide. 1 Plain, 1 Grooved for holding round pieces. Auxiliary Bases for machine or bench use. Swivel "M" Base shown $3.00 Extra. Order NOW! Today!

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No. 000 Vise Mounted on SWIVEL "M" BASE

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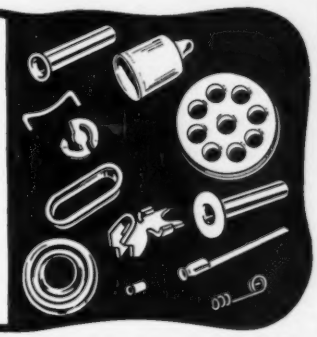

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Designed for Use in Standard Vibrator-Operated Auto Radio Receivers. Built with Precision Construction, featuring Ceramic Stack Spacers for Longer Lasting Life. Backed by more than 20 years of experience in Vibrator Design, Development, and Manufacturing.

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MODEL 126 TAPE RECORDERS

Whatever you put on tape, you can count on the finest reproduction from the Fairchild Model 126 Magnetic Tape Recorder. It is quality designed for a long, useful life . . . for year-in, year-out accuracy and minimum maintenance. That means its final cost is substantially less than other professional recorders. These exclusive Fairchild features explain why.

EXCLUSIVE Highest signal-to-noise ratio of any tape recorder—permits recording with lowest possible distortion and dubbing or transfer without degradation of quality.

EXCLUSIVE Syncroll Drive insures exactly synchronous tape speed from start to finish. Comes up to stable speed faster. Gives you accurate timing of program and on-pitch reproduction. Splice tape from remote sections of roll when required—no change in pitch.

EXCLUSIVE Oversize Capstan, 1¼" diameter with 180° tape wrap, eliminates tape slippage, giving better timing accuracy.

EXCLUSIVE Dynamic Reel Braking insures smooth stops. No friction brakes to wear out.

EXCLUSIVE Pic-Sync Attachment—optional feature. Corrects for tape stretch and shrinkage. Provides absolute timing required for lip synchronous sound on tape with motion pictures and TV programs.

EXCLUSIVE Automatic Framing Control—available with Pic-Sync—brings the recorder into "frame" with movie projector or second tape machine when both are started from standstill, regardless of differences in starting times. Also ideal for editing.

Remember, invest in a Fairchild and you have tomorrow's recorder today . . . at lowest overall cost. Send for bulletin T11, giving complete data.

FR 132

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154th STREET & 7th AVENUE • WHITESTONE, NEW YORK

and noninductive fixed wire-wound resistors.

Rotary Accelerator. Statham Development Corp., 12411 West Olympic Blvd., Los Angeles 64, Calif., has available a 4-page brochure on its rotary accelerator, an instrument that provides a controlled variable centrifugal acceleration for calibrating or testing instruments, electronic subassemblies, small mechanisms and other similar equipment. Acceleration range of the unit described is from 0.1 g to 100 g.

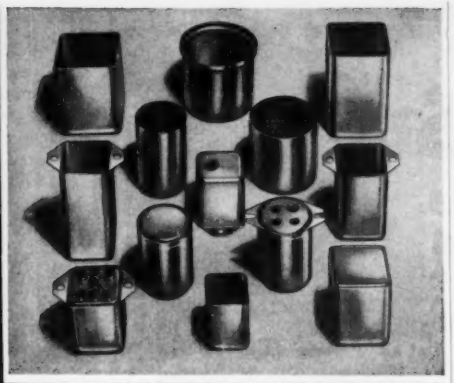
Carbon Film Resistors. Chase Resistor Co., 9 River St., Morristown, N. J., has issued a 4-page folder dealing with a line of 1-percent precision microcrystalline carbon film resistors. Dimensions of the various types, construction information and characteristics are given. Temperature coefficient curves are shown. A price list is included.

Oscillator. Southwestern Industrial Electronics Co., 2831 Post Oak Road, Houston 19, Texas. A 4-page folder describes the model L oscillator that has been designed as a source of power covering the frequency range of 0.01 to 100 cps. An illustration, technical specifications, a page of information on output circuits and prices are given. Also included is a circuit diagram showing a simplified version of the two-amplifier-bridge-stabilized oscillator which is used in the model L oscillator.

Electronic Flow Meter. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. Instrumentation Data Sheet 10.3-5 describes the Potter-Brown Flowmeter for measurement of fluids over an extremely wide range of temperatures and pressures with an accuracy of 0.5 percent. The system described is easily installed, has linear characteristics and can be used to measure, record and control flow at one or more points.

Hermetic Seal Bushings. Heldor Terminal and Bushing Co., Inc., 225 Belleville Ave., Bloomfield,

drawn cases



hot tin dipped . . . fabricated terminal and vent holes . . . smooth, one-piece construction using cold rolled steel . . . draw depths up to 2½" . . . **inside fit covers for easy hermetic sealing in all sizes** . . . available as stock sizes and as special fabrications.

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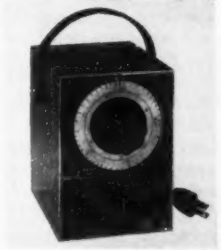

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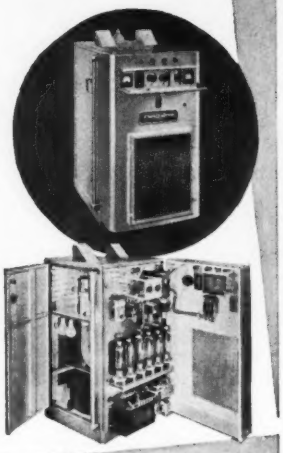
TO MAKE PANELS, LIDS and DOORS
RF TIGHT



Thermatron built by Radio Receptor Co., Inc.

1 **Machine mating surfaces to closest tolerances.** *Costly and difficult!* And the close fit is often destroyed by warping, corrosion and normal use.

2 **Install numerous latches, screws, bolts or other fastenings.** *Also costly!* And makes maintenance more difficult, more time-consuming.

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Made of resilient, compressible *knitted* metal wire mesh, METEX strips and gaskets "close" these openings just as a weatherstrip "closes" windows and doors.

Because they are metallic, METEX strips and gaskets are conductive. Because they are knitted, they are flexible and resilient. They will conform to surface irregularities with no loss in shielding efficiency.

Close manufacturing control assures uniformity in the resiliency and dimensions best adapted to specific applications.

METEX electronic strips and gaskets are easy to install. They are not expensive—in fact, they may well save more than their cost by eliminating the need for many operations formerly thought necessary.

It will pay you to investigate the production and performance advantages of METEX Electronic Weatherstripping. A bulletin giving detailed information is yours for the asking —just write on your company letterhead.

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KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

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N. J. A new, comprehensive catalog gives full technical descriptions and dimensional diagrams of a complete line of hermetic seal bushings. The 40-page presentation features in addition to bushings and terminal assemblies, technical data on studs, washers, steatite, convoluted steatite and glands. Special sections are devoted to the company's MIL-T-27 cans and covers, and attention is focused on a new cover assembly service.

Precision Test Equipment. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y. Eighty-eight pages of loose-leaf perforated bulletins are presented in the latest edition of the test equipment catalog. Subjects covered include attenuators and terminations, impedance measurement and transformation, transmission line components, frequency measuring devices, detection and power measurement, signal sources and receivers and vhf-uhf test equipment.

Tube Booklet. Mullard Ltd., Century House, Shaftesbury Ave., WC2, London, England, recently issued a revised and enlarged edition of a booklet entitled "Valves and Tubes for Industry and Communications. Purpose of the booklet is to provide electronic equipment designers with a convenient guide to the wide range of tubes recommended for communication and industrial applications. Besides abridged data on all available types, the publication includes general operational recommendations and a guide to American (RTMA) types replaceable by Mullard types.

Production Facilities. Sylvania Electric Products Inc., Second Ave., Warren, Pa., has announced a new bulletin describing production facilities available at its Parts Division. The 20-page 2-color publication describes the company's manufacturing and engineering services in the following industries: plastics, formed metal parts, wire, welds, mica and electronic components. The 8 × 10 bulletin contains more than 60

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Every year more and more manufacturers are using Supreme meters as initial equipment in hundreds of electrical and electronic devices. Quality built in every respect with many outstanding features such as EFFICIENT ALNICO BAR MAGNET—SELECTED PIVOTS AND JEWELS—DOUBLE BRIDGE CONSTRUCTION—HIGH TORQUE MOVEMENT—STRONG TOUGH POINTER—RUGGED MOVING ELEMENT. Available in a variety of sizes and types with or without special dials. Write Supreme today about your meter needs. Requests for prices and delivery given prompt attention.

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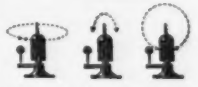

Holds work at any angle in Horizontal, Vertical or Co-axial Plane.

Three sizes of Powrarm—24 to 150 lbs. capacity.

WILTON TOOL MFG. CO.
Precision Built Bench Vises, "C" Clamps and Work Positioners
925-T Wrightwood Avenue • Chicago 14, Illinois

This new Bendix-Pacific development is an extremely compact and very lightweight S-band beacon. It is designed for use in aircraft and guided missiles, to increase the operating range of the tracking radar by reinforcing the normal echo with a retransmitted signal.

Despite its minimum size, the beacon has been fully engineered to withstand the shock, vibration, and temperature conditions encountered in missile installations.

SPECIFICATIONS:

Sensitivity:
—40 dbm signal for steady triggering

Output:
Power: 50 peak watts nominal
Frequency: 2700-2900 mc.

Pulse Width:
.6 microseconds to 3 db points
Repetition Rate of
Interrogator: 200-2500 pps.

Power Requirements:
6.3 volts AC or DC ±10% at 4.0 amps.
300 volts DC nominal at approx. 120 ma.

Controls:
Accessible through end of case. Cavity frequency control. Sensitivity control.

Stability:
Frequency drift less than 3 mc.

Delay Time:
Delay between received and transmitted pulses approximately 1.5 microseconds.

Environmental Conditions:
Acceleration of 55 G's on longitudinal axis for 5 seconds.
Vibration of .06 in. total amplitude at 50 cps for 3 minutes.
Shock of 30 G's for 11 milliseconds in any plane.
Pressure sealed for high altitude operation.
Requires no forced air cooling for continuous operation between —55° C (—67° F) and 38° C (100° F).

Size:
3½ dia. x 12 in. long exclusive of connectors.

Weight: 5.5 lbs.

In addition to the S-band beacon Bendix-Pacific can supply similar equipment to cover the X-band, or to answer only a definite coded interrogation.

Complete engineering assistance is also available for other types of beacons to meet any specific requirement. Complete information will be sent to qualified companies.

Bendix
Pacific Division
Bendix Aviation Corporation
NORTH HOLLYWOOD, CALIF.

illustrations describing plants and services in 10 locations.

Broadband Ferrite-Core Transformers. Sierra Electronic Corp., 810 Brittan Ave., San Carlos, Calif. Several examples of new transformer-engineering techniques are presented in a new folder, Form SA14. Transformers utilize ferrite cores to achieve extremely high permeabilities and efficiences at the higher radio frequencies as well as new insulation techniques which minimize leakage inductance and distributed capacitance. Examples of four typical units are shown by illustration, circuit application and response curves. Also included in the folder is an application chart revealing the areas of frequency and power-handling capacity most advantageously served by transformers of this design. Data are also included on a plug-in adjustable inductor for aircraft radio use at 200 to 400 kc.

Antenna Catalog. The LaPointe Plascomold Corp., Windsor Locks, Conn., has released the 1952 Vee-D-X catalog containing the complete line of antennas and accessories. Containing 24 pages and printed in two colors, the catalog features not only standard Vee-D-X products, but also includes such new developments as the Q-Tee, the Long John, 3 new models of the RW series lightning arresters, the new Mighty Match, and many others.

Atomic-Hydrogen Arc Welding. General Electric Co., Schenectady 5, N. Y., has available a new two-color, two-page bulletin on single-phase, 60-cycle atomic hydrogen arc welding equipment. In addition to explaining the process of atomic-hydrogen welding, bulletin GEC-598A describes the recently redesigned power generating equipment and lists its specifications, applications and advantages. It also covers the features of the companys atomic-hydrogen torch.

High-Vacuum Rectifier. Lewis & Kaufman, Inc., 50 El Rancho Ave., Los Gatos, Calif. A two-page loose-leaf-perforated data sheet de-

INFORMATION on positions at NORTHROP

Northrop Aircraft, Inc. is engaged in vitally important projects in scientific and engineering development, in addition to aircraft production. The program is diversified, interesting and long-range. Exceptional opportunities await qualified individuals.

The most responsible positions will go to top-caliber engineers and scientists. However, a number of excellent positions exist for capable, but less experienced, engineers. Some examples of the types of positions now open are:

ELECTRONIC PROJECT ENGINEERS...
ELECTRONIC INSTRUMENTATION ENGINEERS...RADAR ENGINEERS...
FLIGHT-TEST ENGINEERS...
STRESS ENGINEERS...
AERO- AND THERMODYNAMICISTS...
SERVO-MECHANISTS...POWER-PLANT INSTALLATION DESIGNERS...
STRUCTURAL DESIGNERS...
ELECTRO-MECHANICAL DESIGNERS...
ELECTRICAL INSTALLATION DESIGNERS.
ENGINEERING DRAWING CHECKERS...

Qualified engineers and scientists who wish to locate permanently in Southern California are invited to write for further information regarding these interesting, long-range positions. Please include an outline of your experience and training.

Allowance for travel expenses.

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- *"Multiracks" available with closed or open intermediate sides for rack-to-rack wiring.*
- *Streamlined modern design; beautiful finish.*

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Remember, Par-Metal equipment is made by electronic specialists, not just a sheet metal shop.

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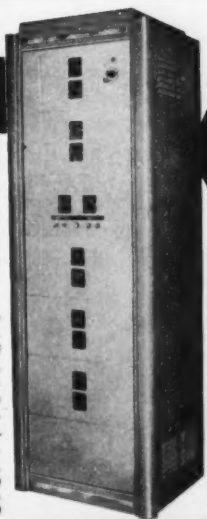

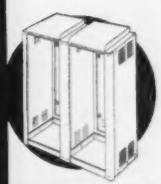

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These Racks may be assembled in multiple units as shown above.
SHELVES available.
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The *ER-225* is priced to compete with racks not having the equivalent features. Beyond doubt — *it's the industry's greatest value.*

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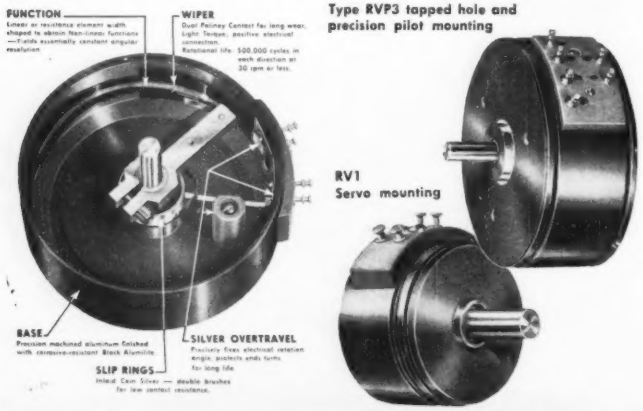
Custom design both mechanical and electrical is a featured TIC service. Precision non-linear pots may be designed to meet customer's requirements from either empirical data or implicit functions. Taps and special winding angles anywhere up to 360° continuous winding can be incorporated into both linear and non-linear precision potentiometers. Greatly expanded facilities plus mass production techniques meet customer volume needs yet maintain precision tolerances in both linear and non-linear potentiometers.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Linear or resistance element width shaped to obtain Non-Linear functions —Yields essentially constant angular resolution
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Dual Paliney Contact for long wear. Light Torque, positive electrical connection. Rotational life: 500,000 cycles in each direction at 30 rpm or less.
Type RVP3 tapped hole and precision pilot mounting
RV1
Servo mounting
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Precision machined aluminum finished with corrosive-resistant Black Alumilite.
SILVER OVERTRAVEL
Positively fixes electrical rotation angle, protects ends turns for long life.
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Inlaid Coin Silver — double brushes for low contact resistance.

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RVP-7	7"	1-500,000 Ω tol. to ± 1%	320° tol. to ± 5°	As low as .05%	6 watts at 25° C.	Servo	Type RVP7-S2 function: $\frac{E_{out}}{E_{in}} = \sin \frac{\theta}{2} \pm 0.1\%$ peak amplitude
RVP-3	3"	Std. values to 200,000 Ω. tol. to ± 1%	320° tol. to ± 5°	As low as ± .1%	6 watts at 25° C.	Servo—tapped hole and precision pilot or threaded bushing	Type RVP3-S4 function: 50 db logarithmic conformity: ±2%, constant fractional accuracy
RV-3	3"	Std. values to 200,000 Ω tol. to ± 1%	315° tol. to ± 5°	As low as ± .25%	8 or 12 watts	3 tapped hole	Available for non-linear functions Note: Phenolic base precision potentiometer, stainless steel or bakelite shaft
RV2	2"	Std. values to 100,000 Ω. tol. to ± 1%	320° tol. to ± 5°	As low as ± .2%	4 watts at 25° C.	Servo—tapped hole and precision pilot or threaded bushing	Type RV2-S112 function: $R = K\theta^n$ conformity: ± 5% over 64° to 320°
RV1-½	1-½"	Std. values to 100,000 Ω. tol. to ± 1%	320° tol. to ± 1°	As low as ± .25%	3 watts at 25° C.	Servo—tapped hole and precision pilot or threaded bushing	Type RV1½-S104 function: $\frac{E_{out}}{E_{in}} = \sin \theta \pm 4\%$ peak amplitude per quadrant
RV1	1-1/16"	Std. values to 50,000 Ω. tol. to ± 1%	320° tol. to ± 2°	As low as ± .5%	2 watts at 25° C.	Servo or threaded bushing	Type RV1-S7 function: $\frac{E_{out}}{E_{in}} = \sin \frac{\theta}{1.78} \pm 4\%$ of peak amplitude
LINEAR TYPES ONLY:							
RV-⅞	⅞"	Std. values to 40,000 Ω tol. to ± 1%	320° tol. to ± 3°	As low as ± 5%	1 watt	Servo or threaded bushing	
RVT	Translatory	10,000 Ω ± 15%	Stroke* 2½"	± 1% total resistance	1 watt	Provides output proportional to a linear displacement rather than a rotary motion of a shaft	

* Special resistance values and stroke lengths from 5 inches to 15 inches can be provided on a custom basis.

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TECHNOLOGY INSTRUMENT CORP.

533 Main Street, Acton, Massachusetts, Telephone: Acton 600

scribes the type 8020 high-vacuum rectifier. It gives operating characteristics for both rectifier and surge-limiting diode operation. The tube is illustrated and outline dimensions are given.

Patch Cords and Jack Panels. Trimm, Inc., 400 Lake St., Libertyville, Ill., has published bulletins R-15a and R-23 describing complete lines of patch cords and jack panels used in broadcast stations and recording studios. Included in the bulletins are descriptions of sub-parts of jack panels frequently useful to laboratories in construction of specialized test equipment.

Vibration Meter. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif., has issued a 4-page bulletin describing the 1-110B vibration meter, an extremely simple and compact instrument that gives direct readings of both linear and torsional velocity and displacement, allowing rapid, easy calculation of the vibrational characteristics of machines and structures. The instrument described incorporates a four-stage, single-channel amplifier, highly stabilized by negative feedback to insure extreme reliability over long periods of time.

Industrial X-Ray Folder. Westinghouse Electric Corp., 401 Liberty Ave., Pittsburgh 30, Pa. In a 4-page folder entitled "Seven Industrial Eyes", seven types of x-ray equipment for industrial application are pictured and described. The units described are: a single-column tubestand unit; an industrial jib crane unit; an ultra-high-speed radiograph unit; a mobile unit; equipment for mass inspection of parts; a wall-mounted industrial x-ray unit; and a thickness gage.

Recording Potentiometer. Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. A recent pamphet introduces the single point recorder of the null-balancing (potentiometer) type, which employs a line-driven synchronous converter and ampli-

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BREADBOARD WHO'S WHO
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quick, accurate answers to any questions about
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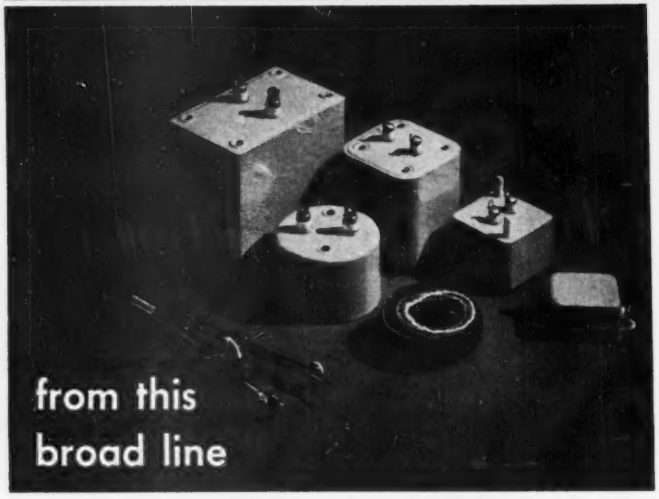

from this
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PRECISION ENGINEERED and manufactured in a modern high-capacity plant, Lenkurt Toroidal Inductors are supplied in the five hermetically-sealed case styles illustrated. These meet the large majority of application requirements. Uncased toroidal coils are available in the same range of inductance values—all being wound on high-Q molybdenum-Permalloy cores and guaranteed within one per cent of nominal inductance value.

RANGING in value from 1 millihenry to 80 henrys, the complete line offers a combination of 42 individual standard values distributed over five case styles. These are available for rapid delivery in quantities to meet your most demanding production schedules. Intermediate values can be supplied on special order. For full details, ask for your copy of the descriptive folder, Form TL-P4.

LENKURT INDUCTORS are made by Lenkurt Electric Company—*largest independent manufacturer of telephone toll-transmission equipment*—also producers of variable inductors, quality filters, decade inductors, and molded iron-powder parts.

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San Carlos 1 California

Lenkurt

fier to control a two-phase motor and rebalance the measuring circuit. The instrument illustrated and described in the brochure can be used to measure and record temperature, d-c current, d-c voltage, resistance, a-c voltage, a-c current, speed, speed ratio, power, frequency, hydrogen ion (pH), light intensity or any other quantity that can be converted into electrical values.

H-V Ceramic Capacitors. Sprague Electric Co., 35 Marshall St., North Adams, Mass. Bulletin No. 606 gives complete details on type 700C high-voltage ceramic capacitors that are molded in moisture-resistant, nonflammable thermosetting plastic, rated at 20,000 v d-c and designed for 85C operation. The capacitors described find broad use as h-v supply filters in tv receivers and c-r instruments and have a standard rated capacitance of 500 $\mu\mu$f.

Industrial Fasteners. Southco Division, South Chester Corp., Lester, Pa., has available a handbook of fastening specialties containing 22 pages of information on industrial fasteners for metal-to-metal and metal-to-wood applications. Blind rivets and a variety of door latching and fastening devices are illustrated in this two-color, spiral-bound book which also includes several pages of frequently used engineering data. Installation procedure, sample applications and complete dimensional information are given for all fasteners.

Flexible Waveguides. Technicraft Laboratories, Inc., Thomaston, Conn. A recent 6-page folder gives an illustrated description of the type V (vertebra), type S (seamless-corrugated) and type L (interlocked) flexible waveguides. Charts are included showing standard lengths available, nominal attenuation in db, angular bend and axial twist. Information on combination assemblies is also given.

Decadal Frequency Generator. Arthur Schomandl, Troger Strasse 32, Munich 8, Germany, has published a 4-page bulletin illustrat-

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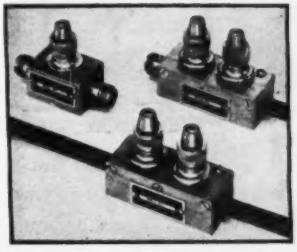

MicroMatch

MM 570 SERIES

4—1200 Watts 20—2000 MCS

This light, compact coupler unit, built into an RF transmission line, continually monitors RF power output, VSWR, and side tone. Monitoring these most important characteristics enables detection of trouble before it can become serious. Converts RF power into DC voltage which is read on indicator circuit meter.

SPECIFICATIONS

FREQUENCY RANGE—20 to 2000 MCS.
IMPEDANCE—51 ohms.
CONNECTORS—Supplied with RG-9A/U cable. N, HN, C, or UHF Type connectors either or both ends. Also available for RG-17/U cable.
POWER RANGES—May be set to provide full scale reading on the indicator for any power level from 4 watts to 1200 watts.
VSWR RANGES—Meter scale reads 0 to infinity. A VSWR of 2.0 corresponds to approximately half scale deflection.
INDICATOR CIRCUIT—Circuit diagram furnished.
METER CALIBRATION—All meter calibration data for both power and VSWR are supplied. Meter scales or meters will be supplied if desired.
ACCURACY—Plus or minus 5% of full scale for RF power. Plus or minus 10% for VSWR.
SIZE—Single coupler 1¾" l. x 1⅛" w. x 2⅝" h. Double coupler 2-15/16" l. x 1⅛" w. x 2⅝" h.
WEIGHT—Single coupler unit 6 ounces. Double coupler unit 8 ounces.
SIDE TONE MONITOR OUTPUT—AF output available for monitoring when used with an AM type transmitter.

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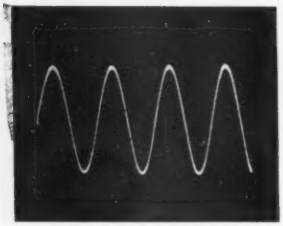
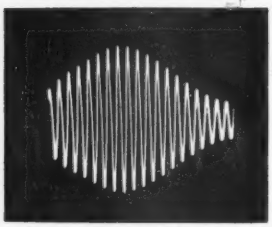
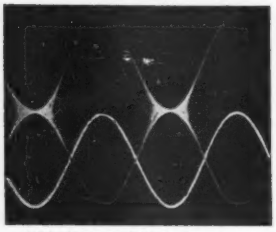


15 kc Unmodulated Carrier



24 kc Carrier modulated at 1000 cps



320 kc Carrier modulated at 400 cps — audio source on lower trace shows fidelity

STANDARD SIGNAL GENERATOR

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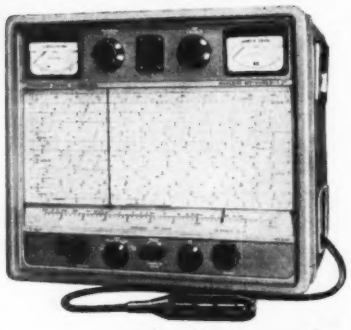
AM WITHOUT FM

100% MODULATION



Excellent amplitude modulation is an outstanding feature — a.m. accompanied by unmeasurable f.m. Other features include: **Wide range** — 15 kc (or less) to 30 mc on 15 ft. high-discrimination full-vision scale. **Crystal Accuracy** — 0.01% with built-in 1 mc harmonic source. **High Output** — 4 volts down to 0.4 microvolts. **Flexible Modulation** — internal 400 and 1,000 cps, external 50-10,000 cps within a db. **Also incorporated:** automatic level control, negative feed-back, modulation monitoring by dual-rectification and variable impedance termination with animated diagram.

A signal generator also ideal as a video oscillator for wide-band television systems.

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ing and describing the type ND5 decadal frequency generator for generation of any desired frequency with crystal accuracy within a range from 1 kc to 30 mc. Output frequency of the instrument described is controlled in a fixed-phase relationship by an input frequency of 100 kc, for which either an available 100 kc standard frequency or the output frequency of any 100 kc crystal-oscillator may be employed.

Tape Recorder. Magnecord, Inc., 360 N. Michigan Ave., Chicago 1, Ill. A recent issue of the company's house organ describes and illustrates the Magnecordette, a tape recorder for use with radio or amplifier systems. The mechanical part of the unit described has separate erase and record-reproduce heads and includes 7½ and 15 in. per second tape speed capstans for either speed with a frequency response of 15,000 cycles ±2 db.

Heavy-Duty Connectors. Cannon Electric Co., 3209 Humbodt St., Los Angeles 31, Calif. An 8-page bulletin covers a rugged heavy-duty connector series having resilient material insulators and grommets made to Army Ordnance specifications. The series described, available in AN shell styles with various accessories, is moisture proof and pressurized.

Solderless Terminals. Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa., has available a booklet dealing with quality control of the entire solderless wire termination process. Of special interest to engineers, designers and manufacturers in the electrical and allied fields, it provides technical information concerning 3-way control of the process from the raw metal, through manufacture, to the finished installation.

Transformers. Milwaukee Transformer Co., 5231 North Hopkins St., Milwaukee 9, Wis., has issued a booklet on its transformers, reactors, filter networks and similar components that are custom-engineered for commercial, industrial, laboratory and government applications. It gives a well illustrated

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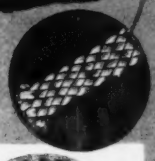

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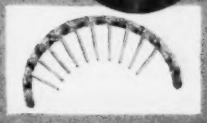

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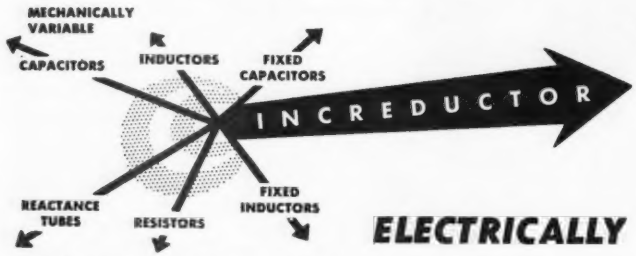

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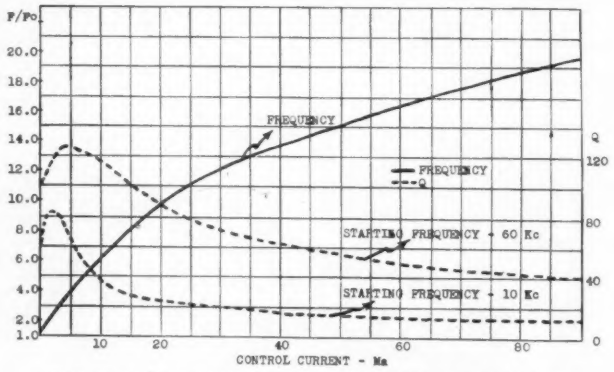
This new wide-range, low-loss, electrically controllable inductor is applicable from sub-audio frequencies to over 100 Mc. Of particular interest at the lower end of this spectrum is the H3M series. These types make available an inductance change of at least 400:1 and may be operated at starting frequencies as high as 80 kc. One of the popular models in this series has a nominal signal winding inductance of 30 millihenries and a control winding inductance of 90 henries. Size is 2-5/16" x 1-15/16" x 1-7/16", hermetically sealed. Typical frequency change versus control current and Q curves are shown in the chart below. A detailed brochure of this unit is available on request and the units themselves are available from stock.



Typical Control Curves of Low Frequency INCREDUCTOR Types #H3M Series

Later advertisements in this series will describe other available units.

Write on your company letterhead for engineering data and technical information on standard types. We will be glad to give you our recommendations regarding your specific problems.

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description of the company's facilities and production techniques. Ordering information is included.

Subminiature Capacitors. Astron Corp., 255 Grant Ave., E. Newark, N. J., has announced new catalog sheets, complete with engineering performance and test specifications, on its new type AQ subminiature paper capacitors. As a result of the newly developed X-250 high temperature impregnant, the capactors described will operate at temperatures up to 125 C without derating.

Hermetically Sealed Components. T. C. Wheaton Co., Millville, N. J., announces catalog W52. In addition to the specifications covering the regular line of hermetic lead-thru terminals and suggestions on how to use them, the company's new glass trimmer capacitors are introduced. An insert covering the specifications on the new WR-8 relay is also included with the catalog.

Transformers and Related Components. Standard Transformers Corp., 3580 Elston Ave., Chicago 18, Ill. A completely revised 24-page catalog and replacement guide contains over 500 separate listings of transformers and related components. A numerical index and price list; classified index, and separate sections for high fidelity, input and interstage, output, driver modulation, power, filter chokes, filament, plate, isolation and autoformers and a separate tv component section are contained in the book. Seventy classifications are indexed in the catalog. Also included are an output transformer chart, matched power supply chart and data on the Stancor-Williamson amplifier.

Ground Plane Antennas. Ward Products Corp., 1523 E. 45th St., Cleveland 3, Ohio, has available a descriptive sheet dealing with three new ground plane antennas. It covers the SPPA-94 that is designed for the amateur two-meter band, 144 to 152 mc; the SPPC-94 that covers many of the aircraft frequencies, operating between

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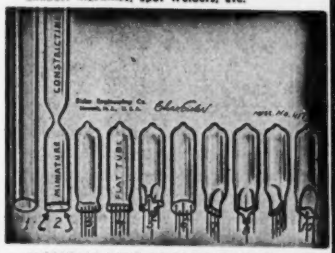

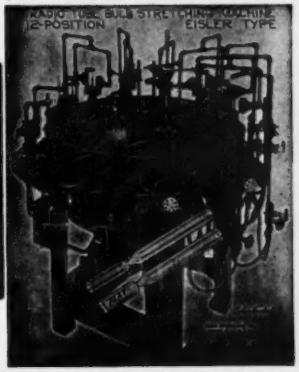

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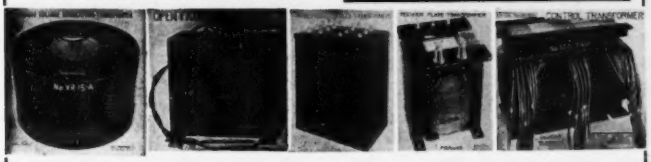

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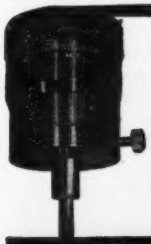

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- Permits the use of oil instead of grease as a lubricant.
- Low starting and running torque.
- Torque constant over long periods.
- Adjusts for pressure variations.
- No heating or scoring at high speed.
- Remains sealed in any position.
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- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.

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PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.

FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS
Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C.
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
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108 and 120 mc; and the SPPD-94 that covers 120 to 132 mc.

Ridged Waveguide. Polytechnic Research & Development Co., Inc. Volume 1, No. 2 of the PRD Reports covers a transmission system that operates over a wider frequency range than conventional rectangular waveguide. It gives a fully illustrated technical description of the ridged waveguide, a rectangular waveguide with a rectangular metal ridge protruding from the center of one broad face. Compared with a rectangular guide of the same fundamental mode cutoff frequency, the ridged waveguide described has five times the attenuation for a bandwidth of four and nine times for a bandwidth of five.

Carrier Amplifier. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Bulletin 1522A describes the type 1-118 carrier amplifier which is designed primarily for the smaller engineering and development laboratory not having a full-time staff devoted exclusively to testing. The instrument discussed is of special interest to engineers engaged in development of high-speed industrial equipment as it greatly simplifies analysis and evaluation of all the h-f and transient physical factors affecting product performance.

Silicone Rubber. General Electric Co., Pittsfield, Mass. Designers, purchasing agents and engineers will be interested in a recently published booklet entitled "Imagineering With Silicone Rubber." The 24-page bulletin CDS-3 includes comprehensive information on properties, applications, classes and design specifications of the company's silicone rubber.

The applications illustrated show how the unique properties of this silicone rubber are helping to make for better products, improve production processes and develop entirely new products. The silicone rubber parts described feature resistance to temperature extremes, release from sticking, inertness and unusual surface properties.

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TEXAS, OKLA. & KANSAS: Thompson Engineering Service, 708 Hemphill St., Fort Worth 4, Texas, Fortune 5340

MIDWEST: Burnis L. Waddle, 3219 West 29th St., Indianapolis 22, Ind. Hickory 8689

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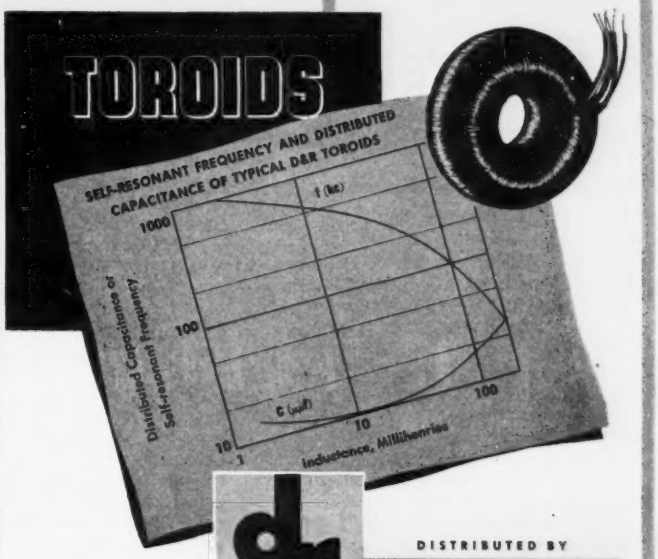

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PLANTS AND PEOPLE

Edited by WILLIAM P. O'BRIEN

Marchant Gets New Division

MARCHANT CALCULATORS, INC., has acquired a controlling interest in Physical Research Laboratories, Inc. of Pasadena, Calif., developers and makers of electronic computers and components. The laboratories will be re-named Marchant Research, Inc., and will be moved to company headquarters at Oakland.

Research activities of the new division will be directed toward developing simplified electronic computers with broad applications in science and business. Electronic components—such as magnetic recording heads for electronic computers, pulse transformer and delay lines for radar and loran equipment—developed by Marchant Research, will be manufactured and sold by Marchant Calculators.

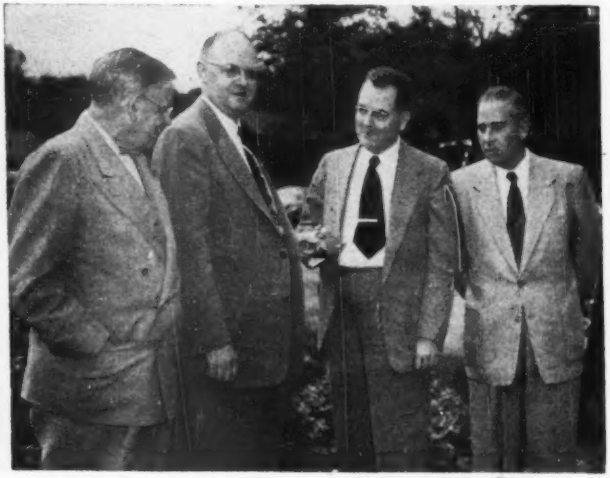
Edgar B. Jessup, president of the parent company, will be chairman of the board of directors of Marchant Research, Inc., and George Greene, who was founder and president of Physical Research Labs, will be president and director. Donald White, co-founder of Physical Research Labs, will be chief engineer and a director.

Battelle Expands

GROUND was recently broken in Columbus, Ohio, for a new million-dollar special-purpose laboratory building for Battelle Institute. Construction was authorized by the NPA because of the important defense research being conducted at Battelle.

Some 300 industrial firms, in addition to the Air Force, Army, Navy and Atomic Energy Commission, are sponsoring important research studies at Battelle. Director Clyde Williams estimates that in the space provided by the new building, Battelle will be in a position to conduct an additional $2,000,000 worth of research for defense agencies and defense industry.

SERVICE AWARD PRESENTATION



Albert C. Gable, second from left, manager of engineering for General Electric's Industrial and Transmitting Tube operations, receives the first Service Award of the Joint Electron Tube Engineering Council at the council's last meeting in Big Moose Lake, N. Y. Presentation of the award plaque was made by Virgil M. Graham, council chairman. At left is Frank J. Martin, council secretary, and at right is Henry J. Hoffman, NEMA director of JETEC. Mr. Gable recently resigned from the council after two years' service, during which he served as chairman of the council's critical materials committee

Beckman Buys Berkeley

BERKELEY SCIENTIFIC CORP., Richmond, Calif., manufacturer of electronic equipment, has been purchased by Beckman Instruments, Inc., of South Pasadena, Calif. The Berkeley Corp. has been dissolved and its operations will continue as a division of the parent company.

W. K. Rosenberry, founder and president of Berkeley Scientific, becomes vice-president of Beckman Instruments in charge of operations at the Richmond plant.

The Beckman organization now has 18 plants or plant sites in the country, and employs 1,400 people. Biggest source of sales is a precision potentiometer made by subsidiary Helipot Corp. The company also makes pH meters, spectrophotometers, computers, radioactivity meters and other devices.

Engineering Changes at Bendix

EDWARD K. FOSTER, vice-president and general manager of the Bendix Radio Division of Bendix Aviation Corp., has announced the appointment of Arthur C. Omberg as director of engineering and research for the division. Adam E. Abel has been named as his assistant. Om-

OTHER DEPARTMENTS featured in this issue:

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Production Techniques	256
New Products	312
New Books	404
Backtalk	420

TO-DAY'S GREATEST SUCCESS . . .

THE AUTO-CHANGER OF TO-MORROW

The "Regent"

. . . a beautifully styled three-speed gramophone. Complete with ingenious automatic stop and light-weight high-fidelity turnover type crystal pick-up fitted with two permanent sapphire styli.

The 'Monarch' auto changer

A masterpiece in design and technical excellence—a three-speed automatic record changer designed to play 12", 10" and the increasingly popular 7" records *intermixed in any order.* The "Monarch" combines ease and simplicity of operation with the high standard of reproduction and performance demanded by the most discriminating listener.

Note these 7 star features.

- Automatically selects and plays 7", 10" and 12" records, intermixed, at 33⅓, 45 or 78 r.p.m. Capacity 10 records.
- Pick-up automatically returned to rest position and motor switched off after last record.
- New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self compensated for the L.P. lower frequencies with the Turnover frequency at the correct point.
- Remarkably compact design makes it an ideal unit for the radiogram/TV combination console.
- Simplicity of design guarantees long life and trouble-free operation.
- Beautiful styling and finish that will harmonize with any cabinet design.
- Operates on 100/125–200/250 volts, 50 cycles A.C. Models also available for 60 cycles A.C.

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149 Broadway, New York 6, N.Y.
Telephone Worth 4-4847

BSR

Birmingham Sound Reproducers Ltd., Old Hill, Staffs. England. Grams 'Electronic Old Hill, Cradley Heath'

berg succeeds W. L. Webb who was recently promoted to the central engineering staff of the Bendix Aviation Corp. in Detroit.

Mr. Omberg, who has been associated with Bendix since 1944, has been assistant director of engineering and research for the past two years.

Adam E. Abel, who becomes assistant director of engineering and research, has been chief radar engineer for the radio division, responsible for the design of both the military and civilian radar which is now being produced by Bendix in large quantity.

New West Coast Manufacturer

LLOYD M. JONES, with KFI A-M—F-M—TV for over 19 years and with KTTV for 1½ years as operations engineer, has left KTTV to embark upon his own manufacturing business. The business will be known as Lloyd's Enterprises, Box 313, Altadena, Calif.

During the war he was with the Radiation Lab at MIT as a staff member. Projects included APG-1, APG-5, APG-8 and APG-15.

The new organization will make new types of test equipment for TV and electronic research.

Co-Design President Named

DONALD E. WILLIAMSON has been named president of the Co-Design Corp., located at 751 Main St., Winchester, Mass. He is former associate director of research of Baird Associates, Inc. The new corporation will engage in engineering and manufacture of special instruments and devices.

Sylvania Promotes Moncton

THE APPOINTMENT of Howard S. Moncton as administrative engineer of the Radio and Television Division of Sylvania Electric Products Inc. was recently announced. He joined Sylvania in 1939 and has been assistant to the manager of the Physics Laboratories since 1943.

Mr. Moncton assumes his new

H. S. Moncton

duties at headquarters of the Radio and Television Division in Buffalo, N. Y. He will be responsible for the coordination of the administrative functions of the division's engineering department.

Audio & Video Names New Board Member

SIDNEY K. WOLF has been appointed to the board of directors of the Audio & Video Products Corp., 730 Fifth Ave., New York City. He was at one time deputy director of the radio and Radar Division of the War Production Board and director of the Communication Division of the Munitions Board.

Kahle Announces Engineering Rep

THE KAHLE ENGINEERING CO. of North Bergen, N. J., has announced the appointment of James B. Lindsay as a special engineering representative for the company.

J. B. Lindsay

Mr. Lindsay, former vice-president of Thomas Electronics, has devoted the past 25 years to the electronics industry. His association with RCA for more than 12 years resulted in many important contributions to the design and development of tube equipment and techniques.

Instrument Labs Acquires Stewart Bros.

STEWART BROTHERS, INC. of Chicago, Ill., manufacturers of telephone and telegraph test equipment for the independent telephone systems in this country and abroad, has been acquired by Instrument Laboratories, also of Chicago, and will be operated as Stewart Brothers, Division of Instrument Laboratories. The acquisition will result in a program of modernization and improvement to make the line of even greater use and value to the telephone industry.

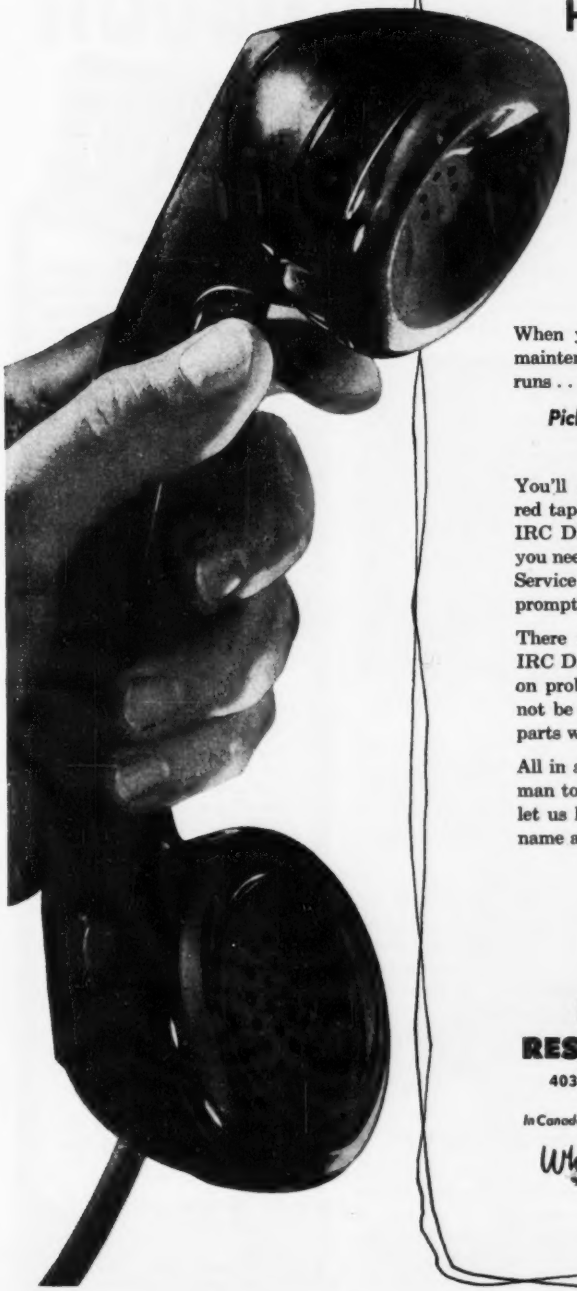
Westinghouse Establishes Fellowship Fund

A FELLOWSHIP fund to help promising young engineers and scientists of the Westinghouse Electric Corp. continue their studies at a graduate level has been established in honor of the late Leon R. Ludwig, inventor (he collaborated in the development of the ignitron rectifier) and company engineering executive. The fund will be administered initially by five company officers.

To be eligible for a fellowship, a candidate must have shown marked ability in engineering or scientific fields and must be a Westinghouse employe of at least two years' service.

Goss Joins RCL

C. GILBERT GOSS, development engineer in electronic circuitry at Oak Ridge National Laboratory for the past four and one-half years, has joined Radiation Counter Laboratories, Inc., as director of electronic research. He has had wide experi-



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Pick up your phone and call your nearest IRC Distributor!

You'll save yourself worry and trouble—red tape and long delivery cycles. For your IRC Distributor *has* the standard resistors you need *right on his shelf!* IRC's Industrial Service Plan keeps him amply stocked for prompt delivery of emergency quantities.

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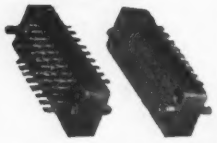
Wherever the Circuit Says -WW-

CONTINENTAL

MINIATURE
Precision
CONNECTORS

RACK TO PANEL TYPE
4 to 100 contacts



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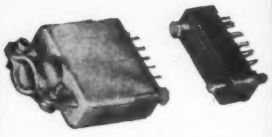
CABLE TO PANEL TYPE
4 to 100 contacts



VOLTAGE BREAKDOWN (Sea level normal humidity) ..... 3600 V. RMS
CURRENT RATING ..... 5 AMPS
CONTACT SIZE ..... 20 AWG wire
EFFECTIVE CREEPAGE ..... ⅛ in.
MECHANICAL SPACING ..... 5/64 in.

CABLE TO PANEL TYPE

Hexagonal type is provided with positive polarization and a Vibration Ring and Spring with detent locking action. Voltage breakdown at Sea level normal humidity. — 1600 V. RMS.

CATALOG WITH COMPLETE DETAILS — AVAILABLE ON REQUEST. TO DEPT. E-10

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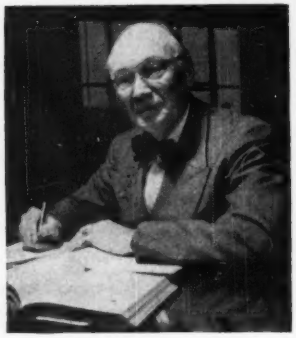
45-01 NORTHERN BOULEVARD, L. I. C. 1, N. Y.

ence with linear amplifiers, scalers, differential discriminators, special voltage supplies and other electronic equipment used in nuclear detection work.

Prior to becoming a member of the staff at ORNL, he was an instructor in electrical engineering at Louisiana Polytechnic Institute.

AIEE Appoints New Committee Chairman

L. F. HICKERNELL, chief engineer of the Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y., has been named chairman of the newly formed Committee on Technical Operations of the AIEE. The new



L. F. Hickernell

committee will be coordinating agency for the AIEE's five technical divisions, which represent 38 technical committees, and will supervise all technical affairs of the Institute.

Philips Plans Java Plant

CONSTRUCTION of an electronic and communications equipment manufacturing plant at Bandoeng, Java, is being planned by the Indonesian Philips Co. In additional to locally recruited manpower, at least 2,000 workers will be brought from Sourabaya, Java.

New Audio & Video V-P

KENNETH B. BOOTHE has been elected a vice-president and director of the instrumentation division of Audio & Video Products Corp., New York, N. Y. This advances him from the position of manager of

DeJUR

EXTERNAL PHASING
C-200
Potentiometers

•MULTIPLE GANGING
•INDIVIDUAL EXTERNAL PHASING
•POSITIVE INTERLOCK
•PRECISION MACHINED ANODIZED ALUMINUM CASE
•ADJUSTABLE TAPS WITHIN ± ½°

Designers are invited to submit their applications to DeJur engineers for recommendations and suggestions.

- 2" Diameter
- 4 Watts Fully Enclosed
- 10 to 200,000 Ohms Accuracy up to 1%
- Linearity up to 0.3%
- Non Linear Windings
- 360° (Continuous) Mechanical Rotation
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- High Resolution 1,000,000 Cycles Operational Life
- Precious Metal Contacts
- Low Torque 1 oz. inch
- Centerless Ground Stainless Steel Shafts
- Ball Bearings to Special Order
- Single or Ganged Units
- Servo Type Mounting or Single Hole Threaded Bushing
- Numerous Shaft Designs

WRITE FOR BULLETIN E-10

DeJUR ELECTRONICS INSTRUMENTS U.S.A. DeJUR AMSCO
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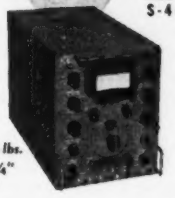
THE SAR PULSESCOPE®

BY WATERMAN

MODEL S-4-A



Weight 31.5 lbs.
9⅛" x 11¼"
x 17¼"

Another example of WATERMAN pioneering, a compact, portable instrument for precision pulse measurements adaptable for all electronic work, including radar and TV. S-4-A SAR PULSESCOPE will portray all attributes of the pulse; such as shape, amplitude, duration and time displacement. In S mode of operation, the unit functions as a wide band oscilloscope, with optional video delay, in either repetitive or triggered sweep conditions. In A mode of operation the unit functions as a precision time measuring device, with internal crystal controlled markers available for self calibration. In R mode of operation a desired small segment of A Sweep is expanded to fill the face of the tube for detailed observation.

Video Amplifier band pass up to 11 mc . . . optional Video delay 0.55 μs . . . Pulse rise and fall time better than 0.07 μs . . . Video sensitivity of 0.5 p to p/inch . . . S Sweep 80 cycles to 400 KC either triggered or repetitive . . . A Sweep 1.2 μs to 12,000 μs, R Delay 3 μs to 10,000 μs . . . Directly calibrated on a precision dial . . . R Pedestal (or sweep) 2.4 μs to 24 μs . . . A & R Sweep Triggers available externally . . . Internal crystal markers of 10 μs ± 50 μs . . . Built in precision amplitude calibration . . . Operates on 50 to 1000 cycles at 115V AC.

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WATERMAN PRODUCTS INCLUDE:

S-5-A LAB	PULSESCOPE
S-10-B GENERAL	POCKETSCOPE
S-11-A INDUSTRIAL	POCKETSCOPE
S-14-A HIGH GAIN	POCKETSCOPE
S-14-B WIDE BAND	POCKETSCOPE
S-15-A TWIN TUBE	POCKETSCOPE

Also RAYONIC Cathode Ray Tubes
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SQUARE WAVES - *6 cy. to 1 mc.*

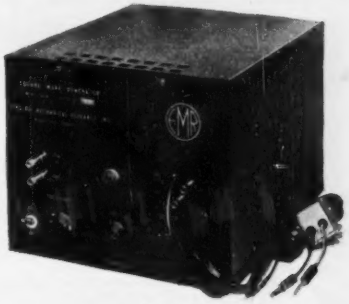
.01 microseconds rise time into 100-ohm load

Negligible overshoot or ringing.

Self contained oscillator may be externally synchronized.

Both frequency control and output attenuator continuously variable.

Outputs include synchronizing pulse.



MODEL 43A
SQUARE WAVE GENERATOR
$230.00 *F.O.B. Ridgefield, Conn.*

MANUFACTURERS OF
DIRECT COUPLED AMPLIFIERS • EXTREMELY HIGH
GAIN 10 CY. AMPLIFIERS • FM/FM TELEMETERING EQUIPMENT

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THERMOSTATIC METAL TYPE

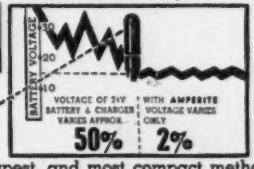
Delay Relays

PROVIDE DELAYS RANGING FROM 1 TO 120 SECONDS

FEATURES: — Compensated for ambient temperature changes from —40° to 110° F . . . Hermetically sealed; not affected by altitude, moisture or other climate changes . . . Explosion-proof . . . Octal radio base . . . Compact, light, rugged, inexpensive . . . Circuits available: SPST Normally Open; SPST Normally Closed.

PROBLEM? Send for *"Special Problem Sheet"*

Regulators



Amperite REGULATORS are the simplest, lightest, cheapest, and most compact method of obtaining current or voltage regulation . . . For currents of .060 to 6 Amps. . . . Hermetically sealed; not affected by altitude, ambient temperature, humidity.

Write for 4-page Illustrated Bulletin.

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In Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto

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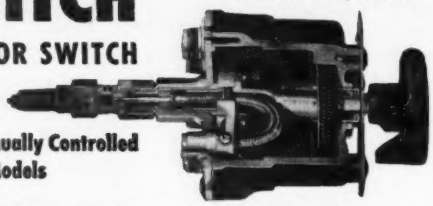
COAXIAL SELECTOR SWITCH

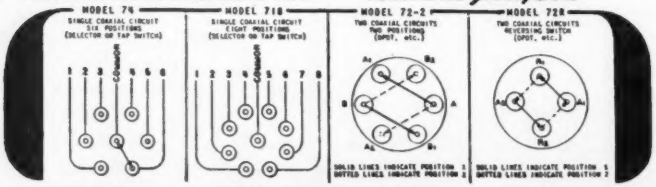
50 Ohms—
Type N Connectors—Manually Controlled
Low VSWR—4 Models

CUT-A-WAY VIEW, MODEL 74



The COAXWITCH is an RF switch for use in coaxial circuits where it is important that the 50 OHM impedance of the cables be maintained. In a circuit sense, this switch consists of two pairs of "N" connectors spaced 4½" apart using RG-8/U as the connecting link. The COAXWITCH itself introduces no VSWR other than that of connectors. Characteristic impedance is maintained thru all switch details. Cut-away view shows that shield as well as center conductor is switched. Beryllium copper contacts, on the gooseneck, mate directly with male "N" (Type UG-21B/U) connectors, which connect directly to back plate of switch. Since all connectors come out in line with axis of switch, right angle connectors are usually unnecessary.

Literature Gladly Sent



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ALSO WRITE FOR FREE LITERATURE ON
★ V-5 Stiffness Gauge ★ Scratch and Toughness Testers For Plastics

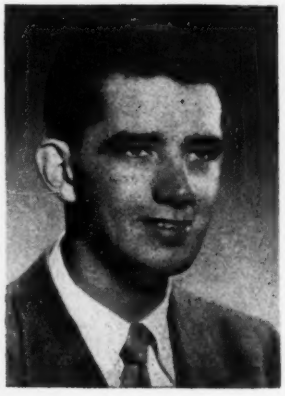
the instrumentation division.

Before joining Audio & Video in 1949, Mr. Boothe was chief engineer and technical supervisor for the United Nations Sound and Recording Department. He organized and directed the engineering for the Paris General Assembly and supervised the simultaneous interpretation and recording installations for the U. N. in Geneva and Havana.

New Chief Engineer

CONDENSER PRODUCTS CO. of Chicago, manufacturer of Glassmikes, capacitors, high-voltage power supplies, pulse-forming networks and plasticon capacitors, has announced the promotion of Tom Murphy to chief engineer.

Mr. Murphy, with the firm for four years, will head the engineering department, which is presently composed of eleven engineers.



T. Murphy

Sylvania Occupies New Site

THE ELECTRONICS DIVISION of Sylvania Electric Products Inc. recently moved its headquarters from Boston to 100 Sylvan Road, Woburn, Mass. Products manufactured in Woburn will be used in such fields as radar, navigation, communication and flight, and will include electron tubes, microwave tubes, semiconductor devices (including transistors) and special-purpose tubes.

Opening of the multi-million dollar Woburn plant brings to six the

from

Accelerometers

to

Yokes

you'll find the correct answer to who makes everything in the entire field of electronics including... components equipment and materials

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New! SELENIUM RECTIFIER POWER SUPPLIES

These General Purpose Power Supplies provide a modern and convenient means of obtaining unfiltered direct current from 115 or 230 volt A.C. power lines. This new series includes 15 models, compactly designed for portability and ideally suited for installations where bench space is at a premium.

Request Bulletin No. 147 for additional information on standard units.

Special Selenium Rectifier power supplies available to specifications. Write for Rectifier Equipment Questionnaire. Proposals and recommendations forwarded promptly.

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Specialists in SMALL quantities of custom built transformers from milliwatts to 50 KVA, single or polyphase—designed and manufactured to best meet your exact requirements.

Each Electran Transformer is built to the highest standards of quality and precision. There is no "second" grade at Electran.

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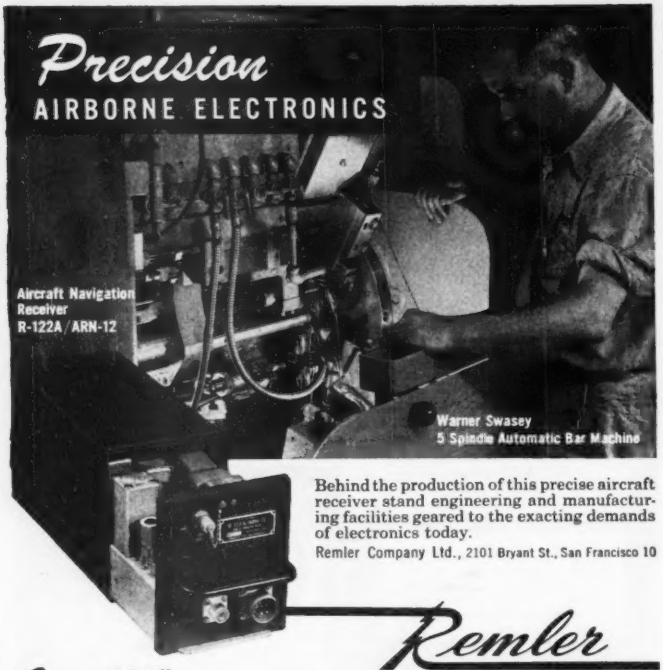

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LOW ATTEN. Types.	IMPED. Ohms.	ATTEN. db/100 ft. at 100 Mcs.	LOAD C. Mmf. per 100 Mcs.	OD"	
A.1.	74	1.7	0.11	0.36	
A 2	74	1.3	0.24	0.44	
A 34	73	0.6	1.5	0.88	HIGH POWER FLEXIBLE
LOW CAPAC. Types	CAPAC. mmf/ft.	IMPED. Ohms.	ATTEN. db/100 ft. at 100 Mcs.	OD"	
C 1	7.3	150	2.5	0.36	
PC 1	10.2	132	3.1	0.36	PHOTOCELL CABLE
C 11	6.3	173	3.2	0.36	
C 2	6.3	171	2.15	0.44	
C 22	5.5	184	2.8	0.44	
C 3	5.4	197	1.9	0.64	
C 33	4.8	220	2.4	0.64	VERY LOW CAPACITANCE
C 44	4.1	252	2.1	1.03	

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CABLES: TRANSRAD LONDON

number of communities in Massachusetts in which Sylvania has manufacturing operations. The Electronics Division last spring opened a new plant in Newton for the production of magnetrons for radar, and the company will retain the Boston plant for production of electronic equipment, such as radar systems and electronic computers.

Hoffman Plants Enlarged

ADDITIONS to the company's Los Angeles plants have been made by Hoffman Radio Corp., making a total factory area of nearly a half million sq ft. The new buildings, with an aggregate of 122,000 sq ft of space, are located at 3764 South Broadway Place and 2034 East 48th St.

Construction has just begun on an annex to the main plant in Los Angeles (3761 So. Hill St.). Cost will be $550,000.

The two buildings already occupied plus the new one will increase the production area by 31 percent.

D&R Staff Addition

LEO JOHNSON, formerly with the Naval Research Laboratory and General Electric Co., has joined the staff of the Magnetics Division of D&R Ltd., Santa Barbara, Calif.

At both GE and NRL his work was in connection with servo projects, computers and the development of high-performance magnetic amplifiers. He will continue his research work on magnetic amplifiers in his present position with D&R.

AiResearch Expands

THE ENGINEERING department of AiResearch Mfg. Co. has been moved to enlarged quarters in a new building at 9225 Aviation Blvd., Los Angeles, Calif. The new engineering building is a single-story structure embracing 37,500 sq ft of floor space.

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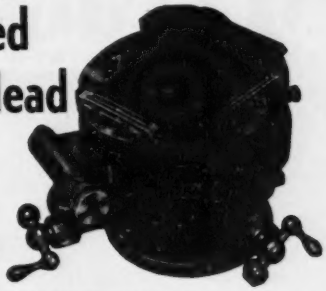

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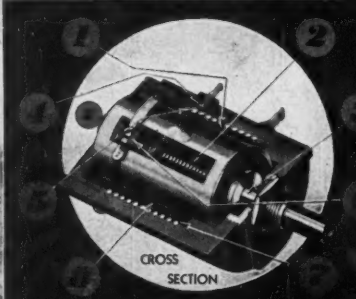

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NEW BOOKS

Principles of Radio

By KEITH HENNEY AND GLEN A. RICHARDSON. *John Wiley & Sons, Inc., New York, 6th ed.*, 1952, 655 *pages*, $5.50.

THE Sixth Edition of "Principles of Radio" keeps this text in the lead in the field of basic radio knowledge. In the same manner that a certain gift is required to teach the fundamentals of a subject to beginners, it is also difficult to write a text for that purpose, particularly so if the material is to be rigorous.

To make certain that the reader has the proper background to understand and follow the radio material, the first nine chapters cover the electrical knowledge essential to radio, and in a manner that invites the student to keep on going and see what is coming up next. A variety of problems are included so that the material will not be the "descriptive" type only.

Then proceeding through several chapters on the vacuum tube and its basic operation, the particular applications of radio are treated to give a well rounded study so that the reader will cover a-m receivers, a-m transmitters, antennas, frequency modulation, ultrahigh frequency phenomena, television and radar. Or if the reader is interested in audio systems there is a chapter on that subject.

A book of this type without a mention of electronic instruments would be incomplete. A very interesting chapter is included on that subject. Also the non-sinusoidal wave and its circuits has been treated. Even the recent developments in color television are described.

The price of the book, based on the number of pages and their contents, is very moderate at present day book prices.—HOLLIS BAIRD, *Northeastern University, Boston, Mass.*

Electronic Measurements

By F. E. TERMAN & J. M. PETTIT. *McGraw-Hill Book Co., Inc., New York*, 1952, *2nd Edition*, 890 *pages*, $10.00.

THE AUTHORS claim that they have extensively revised the senior

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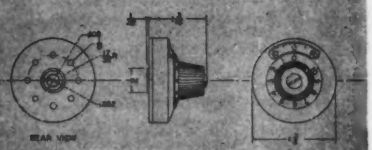

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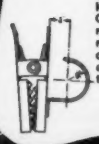

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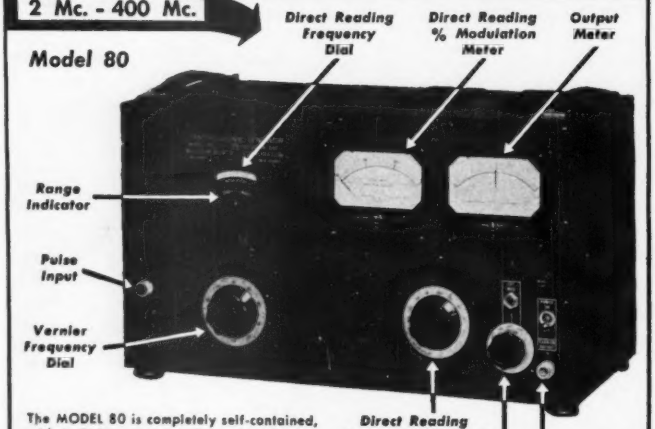

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author's book, "Measurements in Radio Engineering." This is an understatement. The book is essentially a new one—not just a "second edition,"—and the authors' claim that the "change in title is indicative of the increased scope of the new book" is modest, indeed. It is a pleasure to read a book which has obviously been so carefully planned and executed. The intent, as defined in the preface, is carefully followed throughout, and the typography and illustrations are excellent.

The book "has as its aim the providing of a comprehensive engineering discussion of the measuring problems commonly encountered by radio or electronic engineers." The fundamental measurements of voltage, current, and power are first covered, followed by chapters on measurements of circuit constants in both lumped and distributed constant systems. Frequency, waveform, phase and time-interval measurements are discussed. A short chapter on tube characteristics is followed by chapters on amplifier, receiver, antenna and radio wave measurements. Descriptions of various types of laboratory oscillators, reactance and resistance standards, and attenuators and signal generators are given. A chapter on generators of special waveforms contains a wealth of information not readily available in such practical form elsewhere. This latter chapter is unusual to find in this type of book, but it has obviously been included because of its importance as an aid to laboratory measurement techniques.

The specialist in any single field will undoubtedly find his own particular interest too sketchily covered in this text—this is as it should be, for the aim of the text is to present to the student the "experimental aspects of radio in the same comprehensive way that the general principles are ordinarily studied." On the other hand, it will be a very finicky specialist who will not admit that the footnote references will lead the reader, if he so desires, to the latest and best literature in practically every field covered. The references are amazingly complete and up-to-date; a quick glance gives the impression

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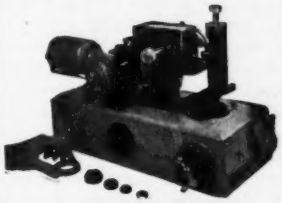

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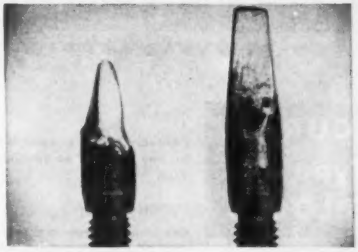

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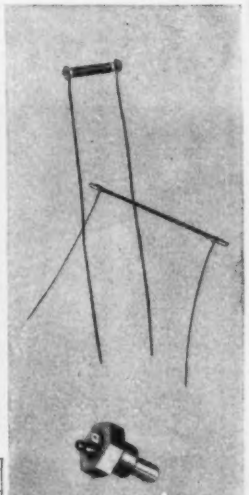

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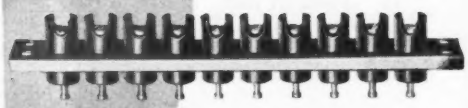

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that over 50 percent are dated subsequent to 1945 and many are dated 1951. The authors are to be commended for the help they have given to the man they term "the practicing engineer." This man will find "Electronic Measurements" in the same category as Terman's "Radio Engineer's Handbook."

It is unfortunate that the criticisms which must be mentioned cannot be printed as footnotes or in very small print, so that their relative importance could be made clear. In lieu of this, they will be short. The section on measurement of feedback amplifier characteristics is very condensed considering the extensive use of such amplifiers and the importance of accurate knowledge of their characteristics. No mention is made of measurements of servo systems, in which a large measure of control of the overall characteristics of the electro-mechanical system rests in the electronic portion of the circuit. The section on noise figure, both in the amplifier and receiver chapters, is rather loosely written and contains several technical errors and misconceptions. (Here the authors may criticize the reviewer for being the "finicky specialist" mentioned above. The accusation is admitted, but the criticism stands.)

On the whole, this book is one which will find its way into the libraries of most engineers in the electronics field. It is an excellent book in an area which has been devoid of one for many years .— MATTHEW T. LEBENBAUM, *Assistant Supervising Engineer, Radar Section, Airborne Instruments Laboratory, Mineola, New York.*

Radio and Television Receiver Troubleshooting and Repair

BY A. A. GHIRARDI AND J. R. JOHNSON. *Rinehart Brooks, Inc., New York,* 1952, 822 *pages,* $6.75.

ASSUMING a basic knowledge of how television and radio receiver circuits work, this vocational text gives major emphasis to techniques for finding and fixing trouble. The first chapter is both orientation and review, stressing the importance of individual components in circuits

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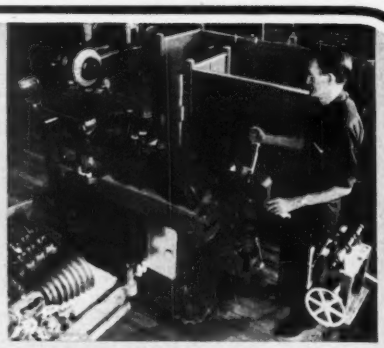

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and discussing briefly the commonest troubles associated with each type of component. The next nine chapters cover the different types of troubleshooting techniques used by practical servicemen on the various types of receivers. Three chapters cover alignment of a-m, f-m and tv receivers respectively; one tells how to take performance data; six chapters cover in detail the repair and replacement of defective components; the last two chapters deal with record players and recorders.

Chapter summaries and review questions greatly improve the effectiveness of the book both for classroom use and home study. Answers to odd-numbered questions are given at the end of the book, presumably to enable home-study readers to grade their own work.

This book merits the same high praise as its predecessor, "Modern Radio Servicing", and can be recommended to anyone desiring to learn how to fix receivers of all types. Though not specifically covering electronic control circuits, it can also serve for training service technicians in that field because many of the circuits and components are the same in the two fields.—J.M.

Handbook of Engineering Fundamentals

OVID W. ESHBACH, *editor. John Wiley & Sons Inc., New York, Second edition,* 1952, 1,000 *pages plus,* $10.00.

FIRST edition of the popular handbook, published in 1936, had for its purpose the embodiment in a single volume of those fundamental laws and theories of science which are basic to engineering practice. Although much of the present volume is identical with material in the first edition, all of the older material has been reviewed, much has been revised, and much new matter appears. Here and there are changes in emphasis as necessitated by newer knowledge and the greater use of MKS units. While the volume has grown, it is not unwieldy or overly expensive.

There are 14 sections divided roughly into tables, mathematics, units and standards, mechanics, aerodynamics, thermodynamics,

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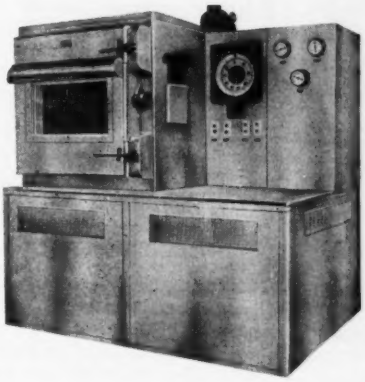

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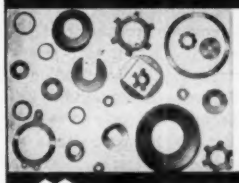

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Electronic Analog Computers

By G. A. Korn and T. M. Korn. *McGraw-Hill Book Co.*, 1952, 378 *pages*, $7.

This text, the first of its kind, should be especially welcome to the newcomer in this field. It represents an integration of the current techniques of application, operation, and design of analog computers, which has heretofore been available only in widely scattered form in periodicals and reports of limited circulation. The authors have succeeded in keeping the treatment mathematically simple so that the qualified electronic engineer should have little difficulty in grasping the essential principles involved while at the same time getting an introduction to the more difficult analytical aspects of the field. Not the least important group who will be benefited by this text, particularly in these days of critical personnel shortages in the computer and associated fields, are the service personnel who form such an essential part of a computer facility. The service personnel, be they maintenance personnel or machine operators, can profitably, with a limited technical training, study this text to increase their effectiveness by a better overall understanding of computer techniques.

In the introductory chapter, the functional characteristics of basic computer components are described. Chapters 2 and 3 deal with the detailed steps in the application or setup of these components into a machine configuration to solve problems. Step-by-step procedures are described and the details are carried out of some specific typical problems. In Chapters 4, 5, and 6 a detailed study of the theory and design of computing elements is

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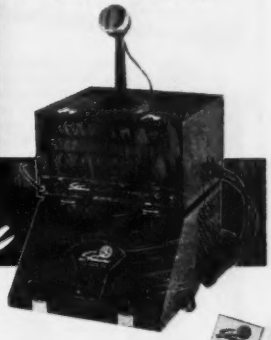

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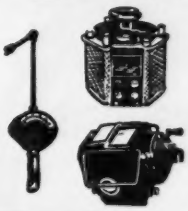

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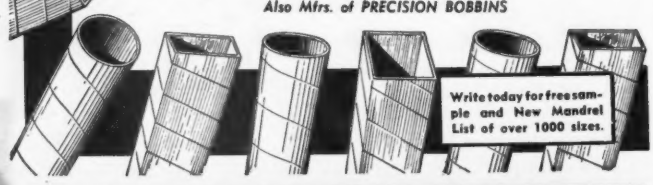

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presented: circuit configurations of feedback amplifiers which add, integrate, and differentiate, and error analyses of such configurations; multiplying and dividing devices employing voltage sensitive elements, and the recently developed step type multipliers; a variety of functional generators which can generate functions of a single variable.

The final two chapters are devoted to such items as power supplies, recorders for plotting results, control circuits, operating procedures, and some of the overall requirements involved in the design and layout of a complete computer installation. The overall design features of several modern analog computer installations are described.

The book should prove popular as an introductory treatment. As a textbook, it has unfortunately the shortcoming that no problems have been included.—DR. W. H. BOGHOSIAN, *Associate Professor, University of Pennsylvania, Philadelphia 4, Pennsylvania.*

Automatic and Manual Control

By A. TUSTIN. *U. S. edition published by Academic Press Inc., New York, 584 pages,* $10.00.

THIS volume is, in effect, the proceedings of a Conference on Automatic Control. The conference, under the auspices of the Department of Scientific and Industrial Research with the support of the Institution of Electrical Engineers and the Institution of Mechanical Engineers, took place at the College of Aeronautics, Cranfield, England, July 1951.

Usefulness

Author and subject indices, in addition to a table of contents, facilitate locating information in the volume. This is especially important because of the breadth of subjects. Each of the three dozen papers deals at the specialist level with a particular aspect of control; for the most part, the authors have assumed that readers are conversant with the current state of the art. In bringing together these related but varied papers that might otherwise appear in several

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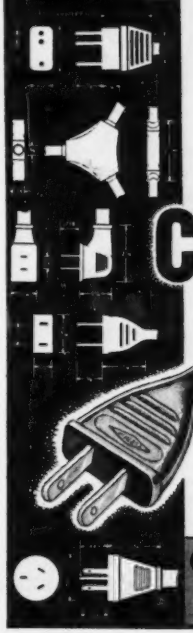

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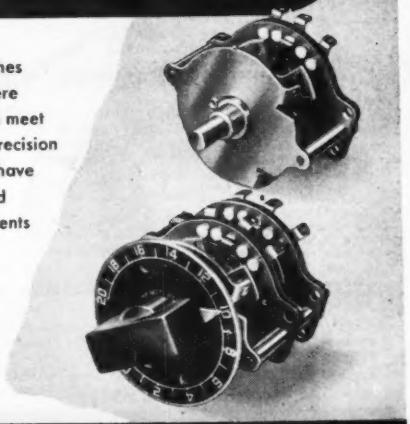

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different journals, the conference committees have provided a volume of widening influence and at the same time relieved society journals of the great pressure from papers awaiting publication. Other conference committees might well study the economies of a book such as this. It takes longer to produce such a book but the result is more legible, although with pages as wide as those of this book, a two-column makeup might have been preferable. Distributing the book through commercial channels brings the conference before as wide an audience as possible.

Organization

The papers are grouped under sections dealing with educational problems, general theory, process control, nonlinear problems, systems working on intermittent data and step-by-step servos, the human operator, descriptions of particular devices and a symposium on analog computers.

The content of the volume is too specialized and varied to discuss adequately in a short review. Engineers dealing with automatic and assisted control will find it an authoritative reference on advanced aspects of servo design.

Examples

The two papers on the human operator illustrate the nature of the conference and of this volume. One paper presents the results of psychological tests comparing free-moving and fixed control levers in manual tracking.

Beyond the specific subject of this paper is the problem of how to evaluate operator error; if the operator is treated as a filter (predictor), by what measure of error shall his performance be judged? This problem is considered in the second paper in which the human transfer function in servo systems is developed for several environmental conditions. The theoretical development, which is based on servo and modern information concepts, provides statistical design criteria such as stability boundaries. The results point the way for obtaining further and much needed experimental data such as that presented in the first paper.

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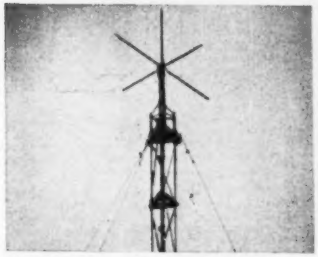

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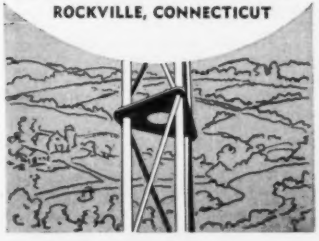

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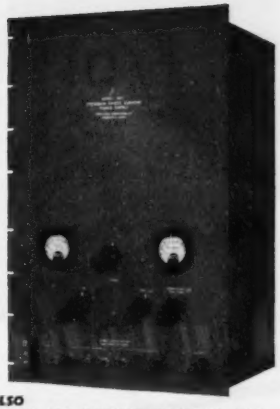

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THUMBNAIL REVIEWS

RADIOLOGICAL MONITORING METHODS AND INSTRUMENTS. Handbook 51, National Bureau of Standards, 1952, 33 pages, 15¢. Indicates types of measurements and instruments necessary to determine adequacy of radiation shielding. Valuable to anyone dealing with x-rays, beta and gamma radiation and neutrons.

WORLD LIST OF SCIENTIFIC PUBLICATIONS, 1900-1950. Edited by William Allan Smith, Francis Lawrence Kent and George Burden Stratton. Butterworth's Scientific Publications, London, and Academic Press Inc., New York, N. Y., 1952, $37.00. A revised and reset third edition listing more than 50,000 volumes. A standard reference work for libraries, editors and research people.

TV TROUBLESHOOTING AND REPAIR GUIDE BOOK. By Robert G. Middleton. John F. Rider, Publisher, Inc., New York, N. Y., 1952, 204 8½ x 11 pages, $3.90. An obviously valuable book for radio service technicians faced with keeping modern complex tv receivers in operation.

ANALYSIS OF ALTERNATING CURRENT CIRCUITS. By W. R. LePage, Syracuse University. McGraw-Hill Book Co., 1952, 444 pages, $6.50. An introductory course devoted to the steady-state in lumped linear networks. Presupposes a knowledge of the elements of a-c and d-c circuits.

EXTENSION AND DISSEMINATION OF ELECTRICAL AND MAGNETIC UNITS BY THE NATIONAL BUREAU OF STANDARDS. By Francis B. Silsbee, NBS. Circular 531, 33 pages, 25¢, 1952. Historical report of the work of NBS in the field of electrical measurements during its first 50 years. Describes processes whereby from the ohm and volt the other units (farad, henry, ampere, watt, joule, gauss and oersted) are derived.

ELECTRONIC RAYS AND SIGHT EQUIPMENT IN TECHNIQUE AND MEDICINE, Vol. 11, by Paul E. Klein, Weidmannsche Verlags buchhandlung, Berlin, Germany, 1952, 356 pages, DM 35.00. Applications of the cathode-ray oscilloscope to numerous fields of science, medicine and engineering. In German. Also by the same author and publisher, Electronic Ray Oscillographs, 212 pages, DM 9.50; and Time and Period Measuring by Cathode-Ray Oscillographs, 60 pages, DM 3.90.

CHARTING STATISTICS. By Mary Eleanor Spear. McGraw-Hill Book Co., 1952, 253 pages, $4.50. Methods of designing and the proper use of basic charts for portrayal of economic and statistical data. Useful to those who lecture or write on economic matters, as well as the drafting room or artist who makes the illustrations for such lectures or articles.

MEASUREMENT OF THICKNESS OF CAPACITOR PAPER. By Wilmer Souder and S. B. Newman, Circular 532, National Bureau of Standards, 1952, 10 pages, 15¢. Discusses methods used at the Bureau, gives statistical analysis of measurements made there, and offers suggestion to laboratory workers dealing with the problem of maintaining capacitor uniformity.

MOLECULAR MICROWAVE SPECTRA TABLES. By Paul Kisliuk and Charles H. Townes, Circular 518, National Bureau of Standards, 1952, 127 pages, 65¢. Gives frequencies, assignment of quantum numbers and intensities of about 1,800 microwave absorption lines of frequency higher than 1,000 mc. Also includes considerable other pertinent molecular data.

NOISE: Causes, Effects, Measurement, Costs, Control. University of Michigan School of Public Health and Institute of Industrial Health, Ann Arbor, 192 pages, $5.00. A valuable series of papers on the problem of noise and its effects on people.

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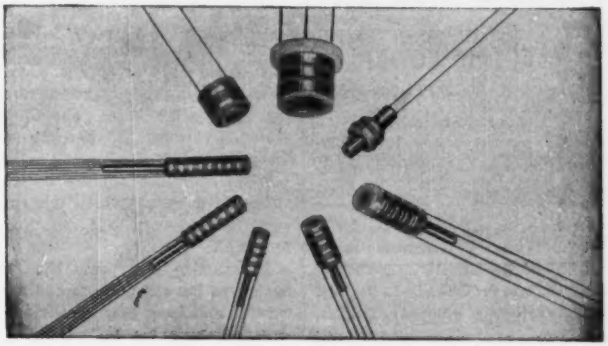

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BACKTALK

Insanitary

DEAR SIRS:

THE DESIGNERS of the amplifier described in the March 1952 issue of ELECTRONICS (40-DB Feedback Amplifier, p 130) make no mention of the fundamental disadvantage of the type of feedback used, a disadvantage which to my mind makes it unfit for use in a high-quality amplifier with a large amount of negative feedback.

The primary of a push-pull output transformer is, in effect, a center-tapped autotransformer with its center tap grounded (for a-c). Consequently, no matter how much out-of-balance there may be in the output valves, approximately equal voltage swings will appear at the two anodes. Therefore the voltages fed back to the cathodes of the driver valves will also be equal, $\pm x$ percent, where x depends mainly on the tolerances in the six resistances in the feedback chains. Now if there is 40 db of feedback the input voltage to the driver valves should be 1 percent greater than the voltage fed back to the cathodes.

If the net input voltages to the driver valves are to be equal to $\pm$ 10 percent the voltages from the phase splitter and the voltages fed to the cathodes from the feedback chains should be matched to about 0.1 percent (i.e. 10 percent of 1. percent). This involves selecting resistors to better than 0.05 percent, which is an absurd requirement for an audio amplifier.

In practice it appears that the designers have not attempted such careful matching but have tried to ensure reasonable balance in the output stage by the very dubious method of unbypassed common screen and cathode resistors, dubious because common screen droppers and bias resistors tend to increase any inherent d-c unbalance, while the omission of cathode and screen bypass capacitors from the output valves reduces the maximum undistorted output even for a per-

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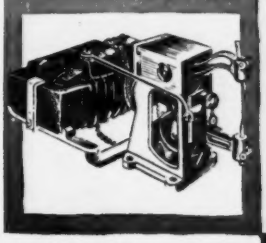

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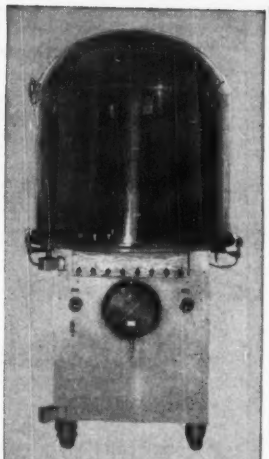

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Please forgive me for troubling you with purely destructive criticism. I sincerely believe, however, that it is wrong that any of your readers, some of whom may have little experience of audio-frequency techniques, should be encouraged to copy an "insanitary" design when much better designs exist.

E. F. GOOD
Malvern, Worcs., England

Grads and Post-grads

DEAR SIRS:

I SHOULD like to register a protest against an impression given in an item appearing on page 8 of the June 1952 issue of ELECTRONICS. This item concerned the shortage of electrical engineering graduates.

First, may I compliment you on gathering the data and presenting it in attractive graphical form. My only point of protest lies in your analysis of the percentage of graduates available to industry. You show a "loss" of 19 percent of the graduates, including 8 percent going into graduate study. The implication seems to be that men disappearing into this status of graduate students do not ever appear again! The fact of the matter is, of course, that in addition to those men graduating this year at the Bachelor's level, there are a substantial number of M.S. and Ph.D. men who undoubtedly compensate in numbers for the 8 percent entering graduate study this year.

To ignore the men emerging from the colleges with advanced degrees is to commit an error not only in numbers, but more importantly in quality. As you well know, there is a very heavy demand from industry at present for men with advanced degrees, and it would be folly indeed if someone should magically change the situation so that the 8 percent of the graduates which you show as "lost" would go with the 81 percent into industry immediately upon graduation.

While the situation at Stanford is perhaps not typical, it might interest you to see how far in error you would be as to our production

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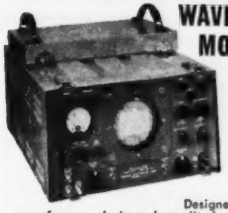

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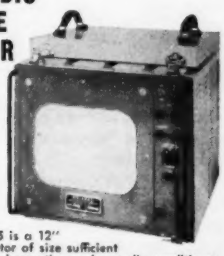

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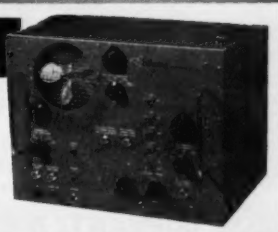

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of engineers for industry if you counted only men with Bachelor degrees. We had 25 such graduates in Electrical Engineering in the 1952 class. For this same year we had 41 graduating with the M.S. degree, 14 with the Engineer's Degree and 19 with the Ph.D. degree, all in Electrical Engineering.

I will not labor you further with this issue, as I am sure you are well aware of the importance to industry of men going on for graduate work. Unfortunately, it seems not to be well known among engineering seniors with whom I have talked at other universities, and even with faculty members. Accordingly, may I urge you in future editorial presentations to lean more in the direction of encouraging graduate work for our best graduates in order that they may make a maximum contribution in later years.

JOSEPH M. PETTIT
Stanford University
Stanford, California

(Editor's Note: Actually, our figures for total electrical engineering graduates included those entering industry at a graduate level. We agree completely with Prof. Pettit's views on the importance of advanced work. Any impression given otherwise is unintentional.)

Three A's

DEAR SIRS:

I READ Doctor Kantor's article in the June 1952 issue of ELECTRONICS, and have been following the back talk in *"Backtalk"* ever since. My reactions have been somewhat of a mixture of approval, amazement and amusement.

I have felt approval because I like to see informative articles such as Dr. Kantor's appear in magazines like ELECTRONICS. As you have seen, interest is always stirred up and productive developments are always forthcoming.

I have felt amazement because I have been active and reasonably productive in the field of electronic instrumentation for application to biological problems for over a decade, and realize the extent which this art has reached. Visit any laboratory or facility devoted to biological research and look about. I venture to predict that you will be unable to find any laboratory in

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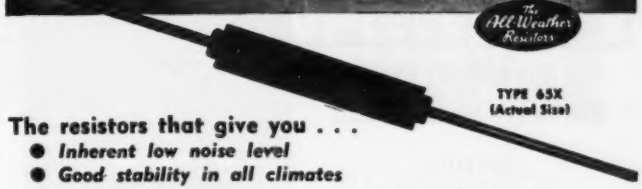

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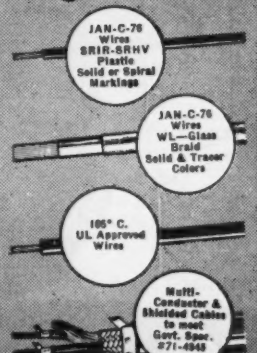
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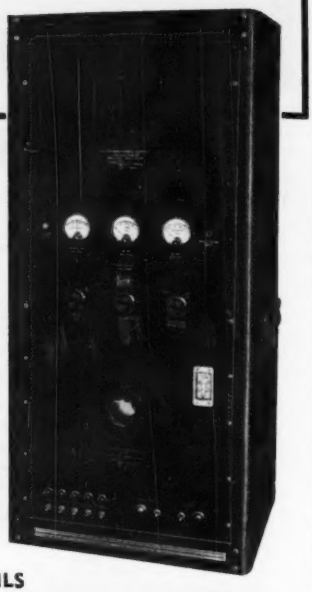

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this country which is not simply filled with a variety of electronic instruments without which the techniques being employed would be impossible.

I find it hard to realize that people in both the biologic and electronic fields can have remained unaware of the impact of electronics upon biologic research. Are they also unaware that every research activity with which I am personally familiar, and that includes a large number, has a full-time electronic engineer as an important and indispensable member of its staff? I suspect that one reason might be that most of our instruments are "one-shot" affairs and with a few exceptions, such as the electroencephalograph and electrocardiograph, have not had much in the way of commercial applications after they have helped supply the answers to the problems for which they were designed and fabricated.

I am also amazed at the general lack of knowledge concerning the existence of the American Instrument Society, and the fine annual meetings held since 1948 on "Electronics in Medicine and Biology" which a joint AIEE-IRE committee has sponsored in New York. The attendance has always numbered several hundred about equally divided between medical and electronics personnel. Maybe next year we should have a subcommittee for missionary work!

I am amused because I have a visit almost everyday from some eager electronics engineer who wants to know what sort of instrument he could make which would be useful to a biologist. I rattle off a number of requirements and he is pleased. He then asks questions concerning the probable market for such things, and I must tell him it is not large. I am forced by honesty to disabuse him of the likelihood of his devising an Idiopathometer[1], and thus having a market for his device comparable to that of the tv industry. When confronted with this unhappy news the eager engineer invariably loses much of his enthusiasm for shoving back the frontiers of biologic knowledge.

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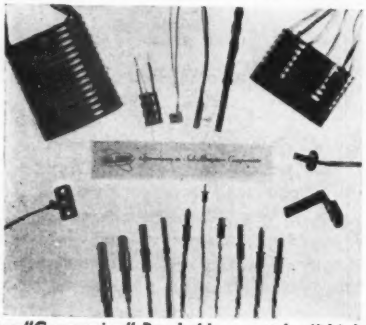

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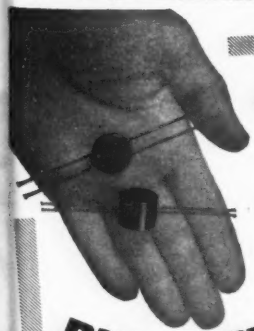

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biology. Let those who doubt that this is so base their conclusion, not on an inspection of their family physician's suite of offices, but rather on a visit to a research organization such as the Lovelace Foundation.

As a clincher, my subscriptions to professional journals have always included ELECTRONICS as well as those devoted to biology and medicine, and it is regarded to be as indispensable as any of the latter. By actual count, fifty percent of the volumes in my working library are reference texts on electronics and electromagnetic physics. I am not regarded as particularly unique—crazy perhaps—but all agree that I have plenty of company!

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[1] Idiopathic—self-caused disease, or disease of unknown cause. We in the business refer to the ultimate apparatus which will diagnose all and treat all as an idiopathometer.

Noise

DEAR SIRS:

A METHOD of measuring uhf-tv receiver noise figures is described in the March issue of ELECTRONICS (p 128). I have been using a simpler procedure of measuring uhf converter noise figures based on a method developed by Goldman in his book, "Frequency Analysis, Modulation and Noise" in the paragraph on noise figures with networks in cascade. He develops the formula

$$F_a = \frac{F_b\,(Y-1) + 1}{G_a}$$

where $Y = N_{ab}/N_b$ and all values are in terms of power.

A suitable tv receiver of known noise figure is set up with the antenna properly terminated. The detector is linearized in the usual manner and the noise output voltage recorded. The uhf converter is then connected to the receiver (keeping the detector linearized) and the noise output again recorded. Knowing the gain of the converter, its noise figure is easily calculated. It is assumed that the converter output impedance and the receiver input impedance are substantially resistive and equal.

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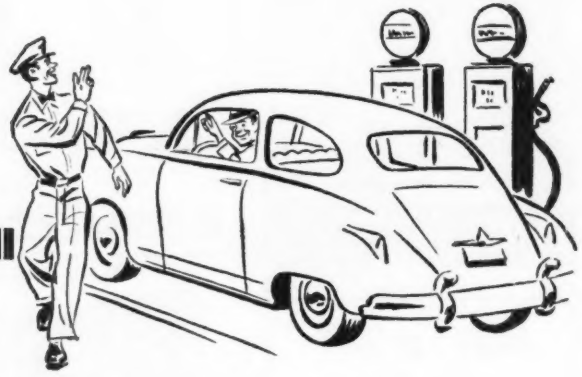
"SEE YOU AT THE POLLS!"

"SEE YOU AT THE POLLS!"



Nobody knows for sure how it started—this line about "See you at the Polls!" we're hearing all over these days.

Best explanation seems to be that it came from that state candidate out west. . . . His opponent in a debate got all riled up and challenged him to fight it out in the alley.

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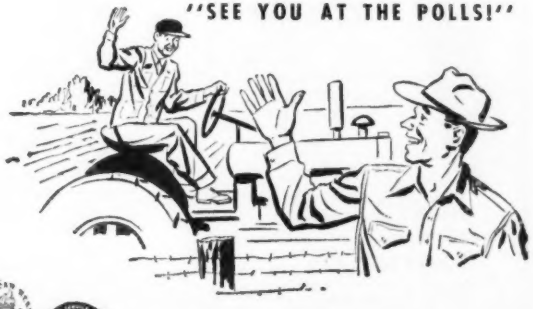
"SEE YOU AT THE POLLS!"

"SEE YOU AT THE POLLS!"



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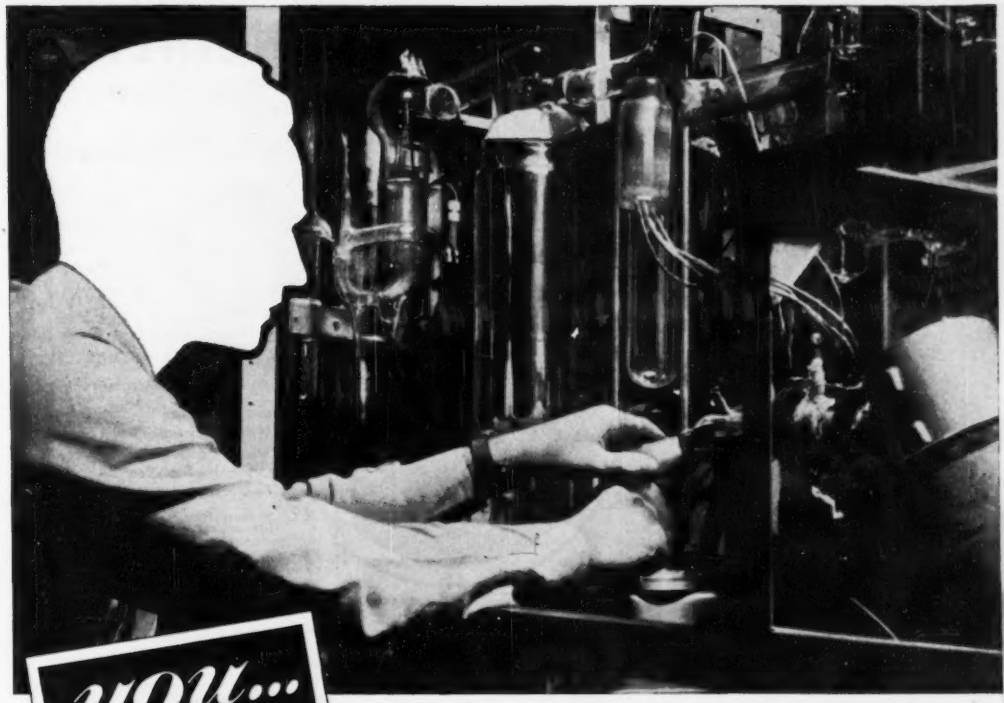

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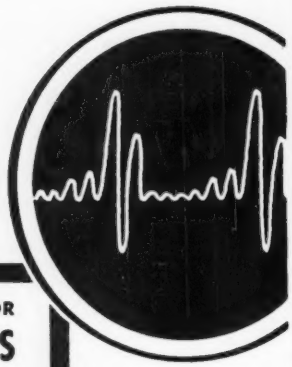

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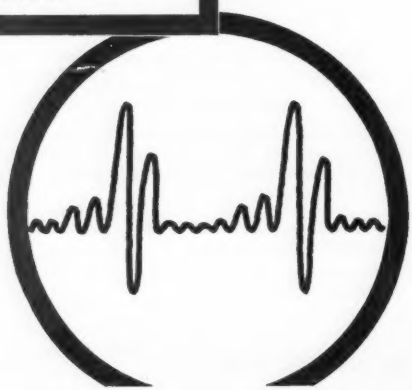

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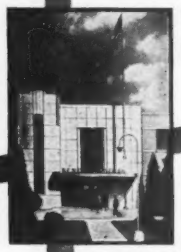

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P.S.

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If interested in employment at York, Pennsylvania, write giving brief resume of your experience to:

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Experience in Design and Development of Radar and Sonar necessary.

Broad knowledge of Search and Fire Control Systems; Servo Mechanisms, Special Weapons, Microwave, Antenna and Antenna Mounts, etc.

Mechanical Engineer should have experience in packaging of Electronic Equipment to Gov't specifications including design of complex cabinets, shock mount and sway brace structures, Servo Mechanisms.

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Mechanical Designers for Research and Engineering

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Duties involve design and layout responsibilities on the board in research and development of UHF equipment, microwave components, and subminiaturization techniques.

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Minimum 3 years' experience
Mathematics & Physic background desirable

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. . . having good theoretical knowledge and thorough practical experience, to do work on *piezo-electrical crystals and associated circuits.* Skill in laboratory work desirable.

We will test your ability. If you are good we will hire you.

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Engineer or physicist experienced in preparation and testing of quartz oscillator plates wanted for investigation of electrical and some chemical properties of quartz crystals. Position offers opportunity to participate in established program for introduction of synthetic quartz crystals. Knowledge of crystallography helpful. Good salary. Submit photograph and details of education and experience.

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P-5321, Electronics
330 W. 42 St., New York 36, N. Y.

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P-5235, Electronics
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Radio Corporation of America
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2	600	.69	4	1500	2.95	.1	7500	2.85	.2	50KV	85.00
2	600 R'd	.69	.1-.5	2000	1.95	1-1	7500	22.50	.25	50KV	95.00
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6	600R'd	1.85	1-1	2500	3.45	.05	16KV	6.95	2.9	660VAC	3.50
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4 x 3	600	2.50	1	3000	3.40	1	20KV	54.00			
10	600	3.25	2	3000	4.50						
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2	1000R'd	.95	2	4000	6.95						
3.5-.5	1000	1.85	.1	5000	1.49						
4	1000	1.95	.2	5000	2.50						
6	1000	2.50	1	5000	6.88						
8	1000	3.25	2	5000	10.50						
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UG-20B/U	1.80	UG-27/U	1.30	UG-85/U	1.75	UG-146/U	2.55	UG-201/U	2.25	UG-275/U	5.50
UG-21/U	.95	UG-27A/U	2.95	UG-86/U	2.50	CW-159/U	.60	UG-203/U	.85	UG-276/U	2.75
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RG-8/U	100.00	RG-19/U	1250.00	RG-35/U	900.00	RG-59/U	60.00
RG-9/U	250.00	RG-20/U	1450.00	RG-54A/U	97.00	RG-62/U	75.00
RG-9A/U	275.00	RG-21/U	220.00	RG-55/U	110.00	RG-77/U	100.00
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G.E. CR5181-1AS—115 V 60 cy. AC contactor—SPST 30 Amp contacts plus two auxiliary SPDT contacts $14.50
RBM—115 V 60 cy. AC coil—DPDT 3 amp Contacts $3.20

METERS

1 MA DC 3½" R. Dejor Mod 310 (0-4KV scale) ..$5.75
500 Microamps. DC—2½" round—Sun 4.30
1ma. DC Fan type—2" scale (rem. from equipt). 3.85
500 ma. DC 2½" R.—General Electric 2.95
2 amp. RF 2½" Sq.—Simpson 3.15
5 amp AC 4½" R.—181 ..... 4.11
30 V DC 2½" R.—General Electric 3.95
3 amp. RF 3½" R.—Weston 6.00

CRYSTAL DIODES

1N21	$1.19	1N27	$1.79	1N41	$11.25
1N21A	1.69	1N31	8.10	1N42	15.75
1N21B	2.50	1N34	.66	1N43	1.55
1N22	1.09	1N34A	.95	1N45	.94
1N23	1.95	1N38	1.70	1N52	1.05
1N23A	3.25	1N39	6.25	1N55	3.15
1N23B	4.25	1N40	10.60	1N60	.55

TYPE "J" POTENTIOMETERS

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
40	SS	5K	1/4"	50K	3/8"
60	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	3/8
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"	$1.25 each	

DUAL "JJ" POTS.—$2.95 ea.

50 SS	330 SS	2500 SS	2.5 meg SS
100 SS	500 SS	10K SS	5 meg SS
250 SS	1K SS	1 meg SS	15K 25K ½"

TRIPLE "JJJ" POTS.—$3.95 EA.

100K/100K/100K ½" 20K/150K/15K ½"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A-2650 W.E. D-173013
A.E. GL832BAO
ANY TYPE—$14.88 EACH
TS-10 Type Handsets $9.25

GENERATORS AND INVERTERS

Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output-AC 115V 10.4A 800 to 1400cy. 1φ: DC 30 Volts 60 Amps. Brand new $38.50
Eclipse-Pioneer type 1235-1A. Output-30 Volts DC 15 Amps. Brand New-Original Packing $15.50
PE-218 Inverters-28 VDC to 115 VAC 400 cy 1500 VA. (New) $49.50
Pioneer Type 650-1B Inverter-28VDC to 120V 800 cy 7 amp AC (used) $22.65
G. E. Inverter-28 VDC to 120 VAC 800 cy 700 VA 1φ $39.50
ATR Inverter 6VDC to 110 VAC 60 cy 75W $22.50
PU-7/AP Inverter-28 VDC to 115 VAC 400 cy 2500 VA (used) $75.00
Eclipse-Pioneer type 1212I-1A Inverter—Voltage and frequency regulated—24VDC 18 Amp input—AC output 115V 3φ 400 cy 250VA 0.7 PF — (New) $225.00

TEST EQUIPMENT

- Gen. Radio 475B Frequency Monitor *$200.00
- Gen. Radio 681A Freq. Deviation Meter *$87.50
- I-72K Signal Generator $49.50
- C-D Quietone Filter Type IF-10 110/220V AC/DC 20 Amps *$9.00
- TS-143/CPN Oscilloscope *$295.00
- Dumont 175A Oscilloscope *$225.00
- Gen. Radio 757-P1 Power Supply *$27.00
- A.W. Barber Labs. VM-25 VTVM *$85.00
- TS-10A/APN Delay Line Test Set $45.00
- TS-19/APQ-5 Calibrator $75.00
- CW1-60PAG Range Calibrator for ASB, ABE, ABV and ASVC Radars $59.95
- CRV-14AAS Phantom Antenna for Transmitters up to 400 MC $11.75
- 3 CM Pickup Horn Antenna AT-48/UP $9.95
- I-138A Signal Generator—10 cm *$185.00
- BC-221 Frequency meter *$125.00
- CW—60ABM Frequency Meter—10 CM $97.50
- Weston Model 1 D.C. Milliameter 150/150MA with leather case $75.00

All Items New Except Where noted * (Exs. Used Condition.)

MISCELLANEOUS EQUIPMENT

I-82F Selsyn Indicator	$6.95
SCR-515 compl. w/Dynamator, control box	69.50
Amperex 1B98 Gamma Counter	9.87
Powerstat 1226—115/230V Input—0-270V out. @ 9 amp.	37.00
EIMAC 35T Ionization Gauge	9.95
R-7/APS-2 Receiver	49.50
FL-8 1020 cycle filter	2.95
RM-29 remote control unit	8.95
RM-14 remote control unit	8.95
RTA-1B 12/24 V dynamotor	40.00
BC-1206-CW2 Receiver	12.95
ASB-4 Radar equip. Complete	175.75
RCA AVR-15 Beacon Recvr	18.50
Navy DP-14 Direction Finder complete	$85.00
CU-24/ART-13 Antenna Loading Cond	4.95
T-85/APT-5 300-1600 MC Transmitter	175.00
Sola #30807 Constant Volt. Transf. 250 VA	49.00
PP-104/APT-5 Rectifier Unit for above	42.50
BC-1016 Tape Recorder	350.00
AN/APA-30	375.00
BC-910A Oscilloscope	147.50
BC-1068 Receiver	57.50
ATJ and ATK TV Block Equip	Quote
BC-348 Receiver	Quote
RTA-1B Transceiver	Quote
T-47/ART-13 Transmitter	Quote
Sperti 1S21 vacuum relay switch (P/O AN/ART-13)	9.50

PULSE TRANSFORMERS

UTAH 9262, 9278, 9280 — **UTAH** 9318, 9340, 9350

G.E. K54J318	Westinghouse 187AW2F
G.E. 68G-627	Westinghouse 232-AW2
G.E. 68G828	Westinghouse 232-BW-2
G.E. 68G929G1	AN/APN-4 Block Osc.
G.E. 80G13	Philco 352-7149
G.E. K-2468B	Philco 352-7150
G.E. K-2469A	Philco 352-7071
G.E. K-2744B	Philco 352-7178
AN/APN-9 (901756-501)	Raytheon UX-7350
AN/APN-9 (901756-502)	Raytheon UX-10066
AN/APN-9 (352-7250)	W.E. D-161310
AN/APN-9 (352-7251)	W.E. D-163247
Westinghouse 132-AW	W.E. D-163328
Westinghouse 139DW2F	W.E. D-164661
Westinghouse 166AW2F	W.E. K5-9563
Westinghouse 176AW2F	

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2000 cy 135W.

Originally designed to record pulse or sinewave modulated signals received by AN-APR-1, AN/APR-2, AN/APR-4, AN/APR-5, BC-348, S-27, ETC. BRAND NEW $147.50

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 Microsec. 200 PPS 67 ohms imped, 3 sections $4.30
7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 Microsec. 200 PPS, 67 ohms imped, 3 sections $6.75
7.5 E4-16-60-67P, 7.5 KV, "E" Circuit 4 sections, 16 microsec, 60 PPS, 67 ohms imped $8.25
15 E4- 91-400-50P, 15 KV, "E" Circuit .91 microsec. 400 PPS, 50 ohms imped, 4 sections $16.50
15-A-1-400-50P, 15 KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped $37.50

LECTRONIC RESEARCH LABORATORIES
715-19 ARCH ST. PHILA. 6, PA.
Telephones - MARKET 7-6771-2-3
"CABLE ADDRESS - LECTRONIC PHILADELPHIA"

GUARANTEED BRAND NEW

TUBE SPECIALS

STANDARD BRANDS ONLY

Receiving Tubes															
0DA	$1.50	6AG7	1.89	6SK7	.89	14A7	.97	3GP1	4.95	2051	1.15	EL-5B	5.95	WE-254A	5.90	885	4.50
01A	.67	6AH6	1.39	6SK7GT	.89	14B6	.93	3HP7	4.91	5548	32.50	4B24	5.75	WE-287A	3.77	886	24.50
01A	.74	6AJ5	2.50	6SL7GT	.96	14B8	1.09	4AP10	4.75	Transmitting & Special Purpose Tubes		4B25/ EL-6CF	8.95	WE-274A	5.90	887	1.70
02A	.67	6AK5	1.35	6SN7GT	.89	14C8	1.29	4AP1	4.95						5.90	889	2.60
0Z4	.74	WE-6AK5	2.85	6SN7WGT	2.30	14C7	1.15	8AP4	4.75					WE-275A	6.95	889	2.40
0Z4A	.98	6AK5W	3.05	6SQ7	.75	14E6	1.09	8BP1	8.75	OA2	$1.20	4J36	150.00	WE-283A	4.25	810	10.95
1A3	.71	6AK6	.99	6SQ7GT	.75	14E7	1.39	8BP4	8.75	OA3	1.51	4J38	120.00	WE-288A	5.87	813	3.60
1A5GT	.72	6AL5	.69	6SR7	.81	14F7	.92	8CP1	4.95	OB2	1.50	4J50	375.00	WE-296A	7.90	813	9.50
1A6	.72	6AL5W	2.90	6SS7	.99	14H7	.93	8CP7	9.80	OB3	1.29	4J52	400.00	WE-294A	5.75	814	3.95
1A7GT	.91	6AQ5	.99	6ST7	1.25	14J7	.93	8FP7	4.95	OC3	1.20	5D21	26.50	304TH	9.75	815	2.75
1AB5	.89	6AQ6	.79	6T7G	1.09	14N7	.93	8HP1	5.75	OD3	1.15	5J23	52.50	304TL	9.75	816	1.45
1B3GT	.99	6AR5	.79	6T8	1.11	14R7	.93	8HP4	5.75	1B21A	2.85	5J29	18.50	307A	5.50	826	1.45
1B4P	1.17	6AS5	.99	6U5	1.19	14W7	.93	8JP1	26.50	1B22	3.25	6-9B	.85	WE-309A	6.45	828	13.45
1C8GT	.85	6AS6	3.50	6U7G	.88	14X7	.93	8JP2	26.50	1B23	9.95	6AN5	6.50	WE-310A	7.45	829	9.95
1C8	.69	6AS7G	4.53	6V6	1.60	19	.89	8JP4	26.50	1B24		6AR6	3.35	WE-313C	4.15	829A	14.50
1C7G	.69	6AT6	.63	6V6G	.89	19T8	1.16	8LP1	19.75	(Westl	12.95	6C21	29.50	316A	.89	829B	14.50
1D8GP	.69	6AU5GT	1.39	6V6GT	.79	22	1.16	8LP5	19.75	1B24(Sylv	18.95	6C24	52.50	327A	4.25	830B	3.95
1D7G	.69	6AU6	.69	6W4GT	.72	24A	.79	8MP1	10.68	1B24A	39.50	6J4	7.95	WE-331A	9.75	832	7.95
1D8GT	.71	6AV6	.63	6W6GT	.99	25A6	.79	7BP1	8.75	1B26	3.73	7-7-11	1.19	WE-343A	185.00	833A	9.95
1E8GP	.71	6BA6	1.04	6X4	.89	25L6GT	.89	7BP7	7.95	1B27	19.84	10T1	.88	WE-346A	2.75	833A	45.00
1F4	.69	6B8	1.29	6X5GT	.89	25Z6	.79	7BP12	14.95	1B29	2.98	10Y	.65	WE-350A	4.95	836	1.50
1F5G	.69	6B7	.97	6Y6G	.99	26	.79	7BP14	14.95	1B32	3.95	13-A	.80	350B	4.95	837	1.85
1F6	.71	6B8	.99	6ZY5G	.89	27	.69	7CP1	14.95	1B35	12.50	15R	2.35	WE-356B	5.45	838	3.25
1G4GT	.69	6B8G	.85	7A4	.99	28D7	1.75	9CP7	12.85	1B36	12.50	15R	.95	361A	4.75	841	.99
1G5G	.69	6BA6	.72	7A5	.88	30	.72	9LP7	9.95	1B38	32.50	REL-21	2.25	368A	6.90	845	.99
1G6GT	.69	6BA7	1.20	7A6	.83	30 Spec.	.68	10BP4	18.50	1B40	4.95	26G	1.85	371A	.95	845	5.75
1H4G	.69	6BC5	.85	7A7	.83	31	.62	10HP6	24.50	1B41	47.50	HK-24	3.95	371B	.95	845W	6.75
1H5GT	.74	6BC7	1.10	7A8	.83	32	.99	12DP7	16.50	1B42	9.80	RK-25	3.82	388A	2.95	849	29.50
1H6G	.99	6BD5GT	1.60	7AD7	1.44	32L7GT	.87	12GP7	16.50	1B54	32.50	FG-32/		WE-399A	4.75	851	67.00
1H6GT	1.01	6BD6	.99	7AH7	1.08	33	.99	12HP7	16.50	1H20	.88	5558	6.75	417A	16.95	852	22.60
1J5G	.74	6BE6	.72	7B6	.83	34	.99	90DP1	9.95	1S21	9.50	RK-34	.49	434A	2.25	853	7.95
1J6G	.95	6BF5	1.10	7B5	.83	35/51	.79	905	6.45	1Z2	3.75	35T	4.95	446	1.95	861	24.50
1L4	.69	6BF6	.82	7B6	.83	35A5	.89	Photo Cells		2B22	2.20	35T Ion gauge	5.95	446A	1.95	864	.39
1LA4	.67	6BG6G	1.92	7B7	.83	35B5	.82	1P21	$24.10	2B23	.75			446B	2.25	865	1.45
1LA6	1.10	6BH6	.99	7B8	.89	35L6GT	.81	1P24	1.27	2C22	.75	35TG	4.95	450TH	42.50	866A	1.48
1LB4	1.01	6BJ6	.99	7C4	.69	35W4	.55	918	1.65	2C26	.49	REL-36	.75	450TL	42.50	869B	45.00
1LC5	.91	6BK7	1.40	7C5	.83	35Y4	.81	919	1.95	2C26A	.49	RK-47	4.92	451	1.39	872A	3.95
1LC6	.93	6BL7GT	1.45	7C7	.83	35Z4GT	.69	925	12.85	2C34	.49	EF-50	.79	471A/ 1B21A	2.75	876	1.45
1LD5	.93	6BN6	1.59	7E5	1.20	35Z5GT	.90	927	1.85	2C39	22.00	VT-52	.65			876	1.60
1LE3	.93	6BQ6GT	1.26	7E6	.88	36	.69	931A	6.95	2C40	16.25	53A	5.60	SS-501	12.50	878	1.85
1LH4	.92	6BZ6	.85	7E7	.83	37	.69	1645	6.95	2C43	26.50	RK-59	2.44	503A	1.95	879	3.50
1LN5	.91	6C5	.75	7F7	.99	38	.69	Thyratrons & Ignitrons		2C43	21.50	RK-60	1.95	506AX	1.47	954	.39
1N5GT	.85	6CB6	.89	7F8	1.59	39/44	.59			2C44	1.50	VT-62(Hr)	1.15	507AX	1.47	955	.70
1N6G	.97	6CD6	.89	7F7	1.32	41	.71	OA4G	$1.32	2C45	29.50	RK-63	22.50	527	12.25	956	.49
1P5GT	.69	6C8G	.96	7H7	.83	42	.89	EL-C1A	4.75	2C51	5.75	VT-47	.48	530	17.29	957	.49
1Q5GT	.99	6CD6G	2.48	7J7	1.32	43	.89	2A4G	1.25	2C53	12.00	RK-49	2.25	531	8.25	958A	.69
1R4	.69	6CL6	1.09	7K7	1.32	45	.89	2B4	2.10	2E22	1.85	72	1.32	532A	3.95	959	1.80
1R5	.89	6D8G	.83	7L7	.97	45Z5GT	.79	2C35	4.95	2E24	4.15	73	1.32	WE-833A	6.00	960	.65
1S4	.71	6E5	1.10	7N7	.97	46	.81	2D21	1.55	2J21A	9.95	RK-75	3.50	559	2.20	1003	.90
1S5	.81	6F5GT	.83	7Q7	.83	47	.99	3C23	9.95	2J22	9.95	VR-75/ 6AJ	1.51	561	3.50	CK-1005	.79
1T4	.81	6F6	.94	7R7	1.40	48	.69	3C31/EL-C1B	3.95	2J26	26.50	HY615	.49	E-1148	.79	E-1148	.83
1T5GT	.71	6F6G	.99	7S7	1.11	49	1.19	3C45	17.50	2J27	24.50	75T	5.80	WL670A	8.70	1201	1.20
1U4	.86	6F7	.85	7V7	1.11	50	1.41	3C45	17.50	2J31	39.50	VR-78/ 6AC	.64	700A	24.50	1203	.69
1U5	.81	6F8G	.91	7W7	1.11	50A5	.91	4C35	28.75	2J32	42.50	VR-90/		700B	24.50	1291	.69
1V	.69	6G6G	1.06	7Y4	.73	50B5	.88	EL-C5B	9.95	2J33	39.50	OB3	1.29	700C	24.50	1294	.69
1X2	1.69	6H6	.83	7Z4	.89	50C5	.88	5C22	53.45	2J34	39.50	VT-98 (Hr)	65.00	700D	24.50	1299	.69
2A3	1.25	6H6GT	.83	10	.45	50L6GT	.79	C6A	6.75	2J36	88.00	C1094E	2.50	701A	6.95	1602	2.25
2A5	.79	6J5	.75	12A	.65	50Y6GT	.92	C6J	9.95	2J37	13.70	100R	2.90	702A	2.25	1613	1.20
2A7	.89	6J5G	.64	12A6	.71	53	.95	FG-17/5525	25.25	2J38	17.50	100TH	10.25	702B	4.25	1614	2.00
2B7	.79	6J5GT	.64	12A6GT	.69	55	.99	FG-33	17.50	2J39	49.50	WE-101D	3.50	703A	6.95	1616	1.07
2B25	.84	6J7	1.09	12A7	1.16	5BK35B	.60	FG-41	12.50	2J40	39.50	WE-101F	3.62	705A	2.75	1619	.39
2X2	.89	6J7	.99	12A8GT	.77	L35B	.32	FG-47	14.80	2J41	175.00	WE-101P	3.62	705A	45.00	1620	6.25
2X2A	1.85	6J7GT	.79	12AH7GT	1.32	56	.69	FG-81A	4.95	2J48	49.50	WE-102F	2.85	706AY	45.00	1622	2.30
3A4	.65	6J8G	1.20	12AL5	.89	57	.89		7.85	2J49	65.00	VR-105/ 6C3	1.20	706BY	45.00	1624	1.95
3A5	1.89	6K8GT	.99	12AT6	.59	58	.89	FG-95/ 5560	25.00	2J50	39.50			706CY	45.00	1625	.65
3A8GT	2.25	6K8GT	.69	12AT7	1.15	59	1.24	2J B51	2.50	WE-113A	1.32	706FY	45.00	1626	.99		
3B7	.57	6K7	.83	12AU6	.79	70L7GT	.91	FG-104/ 5861	24.60	2J54	47.50	HY-114	.75	706GY	45.00	1629	.99
3C6	1.15	6K7G	.58	12AU7	.95	71A	.79			2J55	175.00	WE-117A	.95	707A	9.95	1630	.99
3D6	.57	6K8	1.22	12AV6	.63	75	.89	FG-105	19.50	2J56	150.00	F-123A	8.95	707B	22.50	1631	1.38
3LF4	.91	6K8GT	.96	12AW6	1.20	76	.69	FG-166	95.00	2J61	45.20	WE-124A	3.80	708A	4.85	1632	.75
3Q4	.77	6L6G	1.08	12AX7	1.85	77	.69	FG-172	39.50	2K23	37.50	F-127A	22.50	709A	4.85	1636	3.10
3Q5GT	.83	6L6	1.87	12BA6	.72	78	.79	FG-178	14.50	2K25	33.50	VT-127A	3.60	710A	1.70	1638	.78
3S4	.77	6L6G	1.79	12BA7	.95	79	.89	RX-233A	4.95	2K26	107.15	AB-150	12.50	713A	1.45	1641	1.95
3V4	.67	6L6GA	1.59	12BD6	.99	80	.65	FG-235A/ 5552	94.50	2K28	34.50	VR-150/ OD3	1.15	714AY	10.75	1642	.78
5AZ4	.69	6L7	1.08	12BE6	.70	81	1.41	FG-271/ 5550	62.50	2K29	26.00	FG-190	12.15	715A	6.75	1643	1.17
5R4GY	1.59	6L7G	.95	12C8	.77	82	1.19			2K33	295.00	FG-195	12.15	715B	12.75	1655	1.98
5T4	1.19	6N7	1.19	12F5GT	.79	83	1.11	5551	62.50	2K45	145.00	HF-200	16.50	715C	26.50	1968	.78
5U4G	.69	6N7GT	1.10	12H6	.69	83V	1.45	393A	5.60	2K54	135.00	203A	6.33	715H	1.47	5544	135.00
5V4G	1.07	6P5GT	.96	12J5GT	.69	84/6Z4	.79	394A	4.77	2K55	135.00	203B	6.33	715AY	45.00	5651	3.85
5W4	.82	6Q7	.99	12K8	.83	85	.79	GL-415/ 5559	3.95	2X2A	1.85	204A	49.50	715BY	45.00	5654	5.85
5Y3G	.87	6Q7G	.87	12Q7GT	.87	89Y	.89			2B/27		C-206	3.15	720AY	45.00	K-6483	6.65
5Y3GT	.89	6R7	.99	12SA7	.89	117L7GT	1.89	KU-610	12.50	EL-1C	2.95	211	.95	720DY	75.00	7193	.75
5Y4G	.71	6S4	.72	12SA7GT	.89	117P7GT	1.89	KU-623	39.50	3B23	4.75	WE-211D	12.50	721A	4.90	8005	5.95
5Z3	.87	6S7	1.04	12SF5	.79	117Z3	.97	KU-628	9.95	3B24	5.95	WE-211E	12.50	723A	4.90	8011	.97
6Z4	1.11	6S7G	.99	12SF5GT	.79	117Z6GT	.97	KU-634	39.50	3B24W	7.95	212E	42.50	723A/B	18.50	8012	2.40
6A4	1.38	6SA7	.84	12SF7	.79	FM-1000	1.59	WL-652/ 5551	62.50	3B25	4.50	WE-215A	.74	724A	3.22	8013	2.75
6A6	1.17	6SA7GT	.99	12SG7	.99	Cathode Ray Tubes				3B26	3.75	217C	8.95	724B	3.22	8013A	4.90
6A7	1.05	6SB7Y	1.05	12SH7	.72			WL-654/ 659	82.00	3B27	3.95	221A	1.95	725A	8.95	8016	1.45
6A8	1.08	6SC7	1.20	12SJ7	.79	2AP1	$9.75			3B28	7.75	227A/		726A	14.50	8020	1.39
6AB4	.99	6SC7GT	1.05	12SJ7GT	.89	2AP5	9.75	WL-672	22.00	3C24	1.85	5C27	4.68	726B	45.00	8025	6.95
6AB7	1.89	6SD7GT	.94	12SK7	1.11	2AP1A	10.25	WL-677	39.50	3C27	6.95	WE-231D	2.25	727C	65.00	8026	1.75
6AC8GT	1.19	6SF5	.83	12SL7GT	1.83	3AP4	10.25	WL-681/ 5550	39.50	3C37	32.50	232CH	240.00	730A	25.00	9002	1.50
6AC7	1.11	6SF5GT	.88	12SN7GT	.99	3BP1	7.95			3D21	1.98	WE-244A	5.20	731A	2.45	9003	1.75
6AC7W	3.25	6SF7	.99	12SQ7GT	.79	3CP1	1.25	722A	3.75	3D21A	4.75	WE-245A	2.35	WL-787	9.80	9004	.95
6AD4G	.98	6SG7	.91	12SR7	.89	3DP1	4.85	884	1.85	3E29	14.50	WE-249B	3.50	788Y	1.40	9005	1.95
6AD7G	1.31	6SH7	.89	12SR7GT	.89	3DP1A	6.75	885	1.98	3J31	95.00	WE-249C	3.50	800	1.50	9006	.85
6AE6G	.89	6SH7GT	.89	12X3	1.19	3EP1	4.98	1645	1.80	4-125A	29.50	250TH	22.50	801A	.48	1B9048	3.79
6AF6G	.89	6SJ7	.89	14A4	.97	3FP7	4.95	1906	14.50	4A1	1.18	250TL	22.50	803	4.95	1B9049	3.79
6AG5	.87	6SJ7GT	.89	14A4	.97	3FP7A	6.98	2050	1.80	4B22		WE-252A	5.65	804	8.95	1N9048	2.69

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GENERAL ELECTRIC	ARMA
CONTROL INSTRUMENT	BENDIX
FORD INSTRUMENT	KETAY
HENSCHEL	DIEHL

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SYNCHROS

ARMY ORDNANCE—NAVY ORDNANCE—COMMERCIAL

AY-101D	5D	6DG	X	2JDSE1	C-78348
1CT	5DG	6G	2J1F1	C-64968-6	C-78349
1F	5F	7DG	2J1G1	C-56701	C-78354
1G	5G	7G	2J1H1	C-56776-1	C-78410
1HG	5N	A	2J1M1	C-69405-2	C-78411
1SF	5SF	B	2J5A2	C-69406	C-78414
5B	5SG	M	2J5D1	C-69406-1	C-78415
5CT	6CT	N	2J5HA1	C-77610	C-78670
					C-79331

SYNCHRO CAPACITORS

SYNCHRO BLOWN FUSE INDICATORS

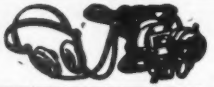
SYNCHRO BLOWN FUSE INDICATORS

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

Sound Powered Chest Set RCA—With 24 Ft. Cord
Per Pair
USED $17.60
NEW $26.40



SOUND POWER HANDSET
BRAND NEW

Includes 6 ft. cord.—No batteries external power source—used.
$18.50 ea.

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
10	39	62	120	240	400	800	.001625	.0044
20	40	70	150	250	430	820	.002	.006
22	47	75	160	270	470	910	.0027	.0065
23	50	80	175	300	500	.001	.0033	.0068
24	51	82	180	330	510	.0012	.004	.0082
25	56	90	200	360	580	.0013		.01
33	66	100	220	370	600	.00136		
		110		390	650	.0015		
					680			

Price Schedule

7 mmf to 910 mmf	5¢
.001 mmf to .001625	8¢
.002 mfd to .0082 mfd	15¢
.01 mfd	28¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
10	40	82	155	270	470	.0011	.0024	.0039
18	50	100	170	360	500	.0013	.0025	.004
22	51	110	180	370	510	.0015	.0027	.005
23	56	115	208	390	525	.0016	.00282	.0051
24	60	120	225	400	560	.0018	.003	00 56
27	62	125	240	410	570	.002	.0033	.006
30	66	130	250	430	680	.0022		.0068
39	68	135	255		700	.0023		.0082
	75	150	260					

Price Schedule

8 mmf to 800 mfd	10¢
.0011 mfd to .002 mfd	20¢
.002 mfd to .0082 mfd	50¢

GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenter's dream! **Only $6.50**

TYPE "J" POTENTIOMETERS

100	S.S.*	1,500	1/4S.S.	15K	1/4
150	S.S.	2,000	1/4	25K	S.S.
300	S.S.*	2,500	S.S.	70K	S.S.
400	S.S.*	3,000	3/8	80K	S.S.
500	1/4	4,000	3/8	100K	7/16
1,000	3/8	5,000	3/4*	100K	S.S.*
1,000	1/4	10K	5/8	200K	5/8

200K	S.S.*		
250K	5/8		
250K	S.S.*		
500K	S.S.*		
1Meg	S.S.		

* Split Locking Bushing **$1.50 EACH**

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15¢ UG175/U	$1.20 83-1F	30¢ 83-1AP	75¢ 83-1J	40¢ SO-239	12¢ HOOD
83-1AC	$.42	UG-22/U	1.30	UG-106/U	.12
83-1AP	.30	UG-22A/U	1.65	UG-167/U	$.70
83-1F	1.20	UG-22B/U	1.50	UG-175/U	.15
83-1H	.12	UG-23/U	1.20	UG-176/U	.15
83-1HP	.22	UG-23B/U	1.75	UG-185/U	1.35
83-1J	.75	UG-23C/U	1.90	UG-201	2.25
83-1R	.40	UG-24/U	1.30	UG-224/U	1.20
83-1RTY	.65	UG-25/U	1.35	UG-255/U	2.45
83-1SP	.50	UG-27/U	1.30	UG-260/U	1.20
83-1SPN	.55	UG-27B/U	3.45	UG-261/U	1.20
83-1T	1.30	UG-30/U	2.30	UG-290/U	1.20
83-2AP	1.95	UG-57/U	2.20	UG-306/U	2.95
83-2J	2.10	UG-57B/U	1.85	UG-499/U	1.25
83-2R	1.70	UG-58/U	.80	UG-625/U	1.35
83-22AP	1.40	UG-58A/U	1.15	CW-123A/U	.50
83-22R	.68	UG-59A/U	2.15	M-358	1.30
83-228P	.80	UG-85/U	1.75	M-359	.30
83-168	.15	UG-87/U	1.60	PL-258	.75
83-185	.15	UG-88/U	1.10	PL-259	.59
83-1F	1.20	UG-89/U	1.35	PL-259A	.55
UG-13/U	1.70	UG-102/U	.80	PL274	1.20
UG-21/U	.95	UG-103/U	.65	SO-239	.40
UG-21B/U	1.35	UG-104/U	1.40		

NEW COAXIAL CABLES

	Price per 1,000 Ft.		Price per 1,000 Ft.
RG 5/U*	$140.00	RG 22A/U	$285.50
RG 6/U	180.00	RG 24/U	675.00
RG 7/U*	85.00	RG 26/U	475.00
RG 8/U*	180.00	RG 29/U*	50.00
RG 9/U*	250.00	RG 34/U	300.00
RG 9A/U	275.00	RG 35/U	900.00
RG 10/U	240.00	RG 41/U*	295.00
RG 11/U*	100.00	RG 54A/U	97.00
RG 12/U	240.00	RG 55/U	110.00
RG 13/U*	216.00	RG 57/U*	325.00
RG 17/U	450.00	RG 58/U*	60.00
RG 18/U	900.00	RG 58A/U	65.00
RG 19/U	1250.00	RG 59/U*	55.00
RG 20/U	1450.00	RG 62/U*	75.00
RG 21/U	220.00	RG 77/U*	100.00
RG 22/U*	150.00	RG11A/U*	150.00

Add 25% for orders less than 500 feet.
* No minimum order—others 250' minimum.

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UNIVERSAL JOINT ALUMINUM
¼" hole x ½" O.D.
1⅛" long **85¢**

PRECISION RESISTORS—¼ WATT—30¢

2	10.48	12.82	14.98	62.54	147.5	705
2.5	10.84	13.02	15.8	79.81	220.4	2,193
3.5	11.25	13.52	16.37	105.8	301.8	3,500
5	11.74	13.89		123.8	366.6	
6.68				125	414.3	59,148

PRECISION RESISTORS—½ WATT—35¢

.25	11.1	75	400	6,500	16,000	36,000
.334	13.15	87	723.1	7,000	16,700	37,000
.444	13.3	97.8	855	7,300	17,000	45,000
.502	15	125	970	7,500	20,150	47,000
.557	25	178	1,500	8,000	21,300	50,000
.627	44.73	179.5	2,500	8,500	25,000	56,000
.76	45	180	2,850	8,800	30,000	59,000
1.00	46	200	3,995	10,000	32,700	59,905
1.01	52	210	4,000	12,000	32,888	68,000
1.53	55.1	235	4,285	14,825	33,000	79,012
2.04	60	260	4,451	15,000	33,300	100,000
3.25	61	270	5,714	15,750	35,888	180,000
5.26	65	290	5,900	15,755		
5.89	66.6	298.3		15,810		
	69					

PRECISION RESISTORS—1 WATT—45¢

.1	2.58	15	60	425	7,000	55,000
.11	2.6	18	125	1,999	8,250	56,000
.2	2.66	28	250	2,250	9,000	65,000
.861	3.1	30	270	3,300	10,000	68,000
1.01	3.39	38	412	5,221	12,000	70,000
1.166	4.29	45.5	420		12,420	84,000
2.55	5.21	54.25			50,000	

PRECISION RESISTORS—1 WATT—60¢

100,000	149,500	270,000	348,000	590,000	
105,000	150,000	296,000	399,000	600,000	
120,000	166,100	310,000	413,000	645,000	
128,000	240,000	320,000	520,000	650,000	
130,000	260,000		522,000	700,000	
132,000					

MEGOHM 1 WATT—1%—$1.50—5%—60¢
PRECISION RESISTORS—2 WATT—75¢

4.385	5,000	6,000	10,000	19,917

Minimum Orders $3.....All orders f.o.b. PHILA, PA.

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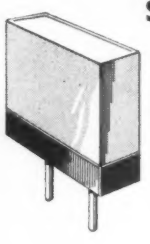

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ALL FT-241-A HOLDERS • MFG. BY WESTERN ELECTRIC

AVAILABLE FOR THE FOLLOWING SETS

SCR 608-A (BC 684) and SCR 628-A 120 per set
SCR 528 (BC 604) and SCR 538 80 per set
AN/TRC 200 KC CRYSTALS (in FT-241-A Holders) For ART-13 and BC 654

QUANTITIES AVAILABLE

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SEARCH RECEIVER—ARD-2

Frequency range 80 to 3000 Mcs.

Measures RF signals from 80 to 3000 Mcs and pulse rates from 50 to 8000 cycles.
The ARD-2 can be used as a Direction Finder to locate signals, or as a frequency meter, by VISUAL and AURAL indicators, provide Originally designed and used by USN aircraft. Ideally suited for military, laboratory and general purpose use.
Equipment consists of the following:
Antenna Detector-CMD-66AFH — Has variable length antennas, diode detector and silver plated tuning stub with calibrated scale.
AMPLIFIER CMD-50ADC—has three stage pulse amplifier, a trigger circuit, a pulse rate counter circuit and audio amplifier, visual signal indicator, rectifier power supply which is operative on 115 Volts AC 60 to 2400 cycles current, regulated.
Test OSCILLATOR-CMD-60ABG — Has cavity frequency of 400 cycles with selection of four pulse repetition rates.
ALL CABLES AND FITTINGS, ACCESSORIES AND SHOCK MOUNTED RACK for immediate installation, plus two Technical Manuals.
SPARE PARTS—Steel chest includes spares for components and two extra sets spare tubes.
Guaranteed NEW

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Wt.: 113-lbs

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8S-1S	$1.59	1.63	1.19	1.59	2.61	18-25S	$3.21	2.87	1.73	3.65	3.65
8S-1P	1.53	1.59	1.19	1.59	2.67	18-25P	2.72	2.76	1.68	2.96	4.00
10S-2S	1.48	1.53	1.08	1.39	2.47	18-26S	3.21	2.87	1.73	3.65	4.48
10S-2P	1.43	1.48	1.08	1.48	2.52	18-26P	2.72	2.76	1.68	2.96	4.00
10S-3S			1.73	2.67	2.67	18-27S	3.25	2.92	1.83	3.80	4.44
10S-3P	1.73	1.77	1.43			18-27P	2.96	3.07	2.03	3.21	4.44
10S-4S				1.53	2.76	18-28S	3.25	2.92	1.83	3.80	4.44
10S-4P	1.59	1.63	1.19			18-28P	2.96	3.07	2.03	3.21	4.44
12S-1S	1.63	1.73	1.19	1.97	2.72	18-29S	3.60	3.25	2.17	4.40	4.79
12S-1P	1.68	1.68	1.24	1.97	2.87	18-29P	3.80	3.45	2.37	4.59	4.99
12S-2S	1.63	1.73	1.19	1.97	2.72	18-30S	2.96	3.11	2.08	3.21	4.97
12S-2P	1.68	1.68	1.24	1.97	2.87	18-30P	3.31	2.92	2.12	3.76	4.99
12S-3S	1.63	1.73	1.19	1.97	2.72	18-31S	2.96	3.11	2.08	3.21	4.49
12S-3P	1.68	1.68	1.24	1.97	2.87	18-31P	3.31	2.92	2.12	3.76	4.99
12S-4S	1.99	1.53	1.04	1.59	2.72	20-1S	4.44	4.69	3.60	4.75	4.84
12S-4P	1.39	1.53	1.04	1.59	2.72	20-1P	5.63	6.32	3.91	5.92	5.97
12-5S	1.59	1.92	1.39	1.97	3.01	20-2S	3.25	3.36	1.92	4.05	4.25
12-5P	1.53	1.73	1.24	1.92	3.01	20-2P	3.11	3.31	1.83	3.45	5.09
12S-6S	2.37	2.37	1.84	2.67	3.73	20-3S	3.71	3.76	2.23	4.25	4.69
12S-6P	2.14	3.49	2.61	3.79	4.56	20-3P	3.41	3.56	1.97	3.80	4.84
14S-1S	1.77	2.08	1.53	2.37	3.16	20-4S	3.36	3.36	2.08	3.76	4.93
14S-1P	1.77	2.03	1.33	2.32	3.16	20-4P	3.16	3.20	1.92	3.71	4.84
14S-2S	1.88	1.97	1.43	2.41	3.25	20-5S	3.07	3.16	1.68	3.45	4.40
14S-2P	2.08	2.17	1.63	2.37	3.50	20-5P	2.87	2.92	1.53	3.56	4.20
14-3S	2.03	2.08	1.43	2.17	3.05	20-6S	3.25	3.45	2.08	3.60	4.40
14-3P	2.08	2.12	1.43	2.57	3.95	20-6P	3.25	3.31	1.83	3.60	4.20
14S-4S	1.70	1.70	1.43	2.27	3.16	20-7S	3.51	4.15	2.87	3.80	5.09
14S-4P	1.99	2.51	1.99	2.57	3.97	20-7P	4.35	4.69	3.25	4.64	5.99
14S-5S	2.12	2.32	1.57	2.47	3.71	20-8S	4.40	4.44	3.01	5.33	5.33
14S-5P	2.12	2.37	1.59	2.81	3.71	20-8P	4.20	4.29	2.81	4.89	5.09
14S-6S	2.37	2.37	1.84	2.67	3.97	20-9S	4.39	4.40	2.92	4.79	5.28
14S-6P	2.61	2.61	2.08	2.96	4.09	20-9P	4.15	4.20	2.76	4.64	5.09
14S-7S	2.23	2.23	1.63	2.76	3.76	20-10S	3.36	3.36	2.08	3.76	4.93
14S-7P	1.97	1.97	1.43	2.27	3.16	20-10P	3.16	3.20	1.92	3.71	4.84
14S-8S	2.08	2.08	1.53	2.37	3.56	20-11S	4.44	5.04	3.60	4.75	5.92
14S-8P	1.97	1.92	1.43	2.23	3.36	20-11P	5.63	6.03	4.59	5.92	6.92
14S-10S	2.17	2.17	1.63	2.52	3.65	20-12S	3.56	3.68	2.17	4.44	4.49
14S-10P	2.32	2.32	1.78	2.52	3.65	20-12P	3.80	3.96	2.32	4.84	4.59
14S-11S	2.17	2.17	1.63	2.52	3.65	20-13S	3.65	4.75	2.27	4.84	4.59
14S-11P	2.37	2.37	1.83	2.72	3.85	20-13P	3.11	3.76	2.27	3.45	4.59
14S-12S	2.08	2.08	1.53	2.37	3.56	20-14S	3.80	4.44	2.81	4.59	5.28
14S-12P	2.08	2.08	1.53	2.37	3.56	20-14P	3.91	4.44	2.92	4.15	5.28
14S-13S	2.08	2.08	1.53	2.37	3.56	20-15S	4.55	4.69	3.21	5.19	5.53
14S-13P	2.08	2.08	1.53	2.37	3.56	20-15P	3.75	4.07	2.61	4.89	4.93
14S-14S	2.17	2.17	1.63	2.52	3.65	20-16S	4.55	4.79	3.31	4.97	5.63
14S-14P	2.37	2.37	1.83	2.72	3.85	20-16P	4.44	4.49	3.11	4.89	5.43
16S-1S	2.61	2.87	2.23	3.21	3.85	20-17S	4.44	4.55	3.11	5.63	5.43
16S-1P	1.87	2.12	1.40	2.67	3.50	20-17P	4.44	4.49	3.11	4.59	5.19
16-2S	2.27	2.32	1.68	2.72	3.56	20-18S	4.84	4.93	3.41	5.83	5.83
16-2P	2.08	2.12	1.48	2.47	3.56	20-18P	4.25	4.29	2.81	5.43	5.24
16S-3S	2.83	2.87	2.13	3.41	3.85	20-19S	4.20	4.25	2.81	5.39	5.19
16S-3P	1.83	1.92	1.24	2.23	3.41	20-19P	3.91	4.15	2.72	4.21	5.04
16S-4S	1.92	2.03	1.39	2.37	2.92	20-20S	4.25	4.29	2.81	4.40	5.24
16S-4P	1.92	2.03	1.39	2.32	3.56	20-20P	3.80	3.91	2.41	4.40	4.79
16S-5S	2.17	2.17	1.73	2.52	3.65	20-21S	4.44	4.75	3.25	4.84	5.63
16S-5P	2.17	2.23	1.59	2.57	3.76	20-21P	4.44	4.44	3.11	5.43	5.43
16S-6S	2.17	2.37	1.53	2.67	3.91	20-22S	4.44	4.55	3.11	5.43	5.43
16S-6P	2.12	2.37	1.71	2.72	3.91	20-22P	4.44	4.44	3.11	4.89	5.28
16-7S	2.67	2.72	2.08	2.81	4.15	20-23S	3.71	3.80	2.32	4.64	4.69
16-7P	2.37	2.52	2.32	2.81	3.91	20-23P	3.36	3.45	2.03	3.80	4.35
16S-8S	2.37	2.72	2.08	3.07	3.65	20-24S	3.91	4.00	2.57	5.04	4.89

List Prices Shown—Deduct 50% on Black Inserts—40% on Melamine Inserts

Insert	Shell 3100	3101	3102	3106	3108	List Price Insert	Shell 3100	3101	3102	3106	3108
22-24S	$4.15	4.09	2.72	4.20	5.48	28-22S	$6.81	6.81	4.49	7.65	8.05
22-24P	3.65	3.71	2.23	3.96	4.99	28-22P	6.37	6.97	3.76	6.96	7.25
22-25S	4.15	4.20	2.72	5.24	5.48	32-1S	6.67	6.86	4.40	7.90	8.34
22-25P	3.80	3.80	2.37	4.40	5.19	32-1P	5.82	6.32	3.91	6.72	7.76
22-26S	4.49	4.49	3.11	4.75	5.83	32-2S	6.67	6.86	4.40	7.90	8.42
22-26P	4.20	4.25	2.81	4.75	5.53	32-2P	6.08	6.32	3.95	7.06	7.90
22-27S	4.89	5.09	3.71	5.33	6.43	32-3S	7.25	7.41	4.93	7.25	8.89
22-27P	4.29	4.84	3.31	4.75	5.92	32-3P	6.57	6.81	4.44	7.45	8.34
22-28S	4.85	4.85	3.16	5.77	5.92	32-4S	7.30	7.56	5.02	8.29	9.42
22-28P	3.80	3.85	2.37	4.98	5.19	32-4P	6.92	7.01	4.64	8.05	8.54
22-29S	4.79	4.84	3.41	5.39	6.12	32-5S	6.32	7.25	4.25	6.67	8.20
22-29P	4.49	4.49	3.11	5.43	5.83	32-5P	6.08	6.92	3.86	6.03	7.01
22-30S	5.19	5.91	4.64	5.59	6.81	32-6S	10.76	10.86	8.44	11.90	12.40
22-30P	5.88	5.92	4.49	7.10	7.21	32-6P	9.33	9.42	7.06	9.62	10.96
22-32S	5.95	6.00	4.61	6.68	7.33	32-7S	12.81	10.72	8.99	11.76	12.29
22-32P	3.76	3.76	2.32	4.35	5.04	32-7P	9.73	9.82	7.16	9.43	11.41
22-33S	3.95	4.20	3.11	4.40	5.77	32-8S	9.73	9.88	7.45	10.86	11.41
22-33P	4.20	4.25	2.81	5.13	5.53	32-8P	8.98	9.13	5.83	10.12	10.66
22-34S	4.15	4.20	2.72	4.89	5.48	32-9S	8.48	8.64	6.61	9.38	10.46
22-34P	3.80	3.95	2.52	4.29	5.28	32-9P	7.45	7.56	5.09	8.54	9.09
22-35S	4.35	4.35	2.92	5.53	5.43	32-10S	7.88	8.14	5.73	8.69	9.68
22-35P	4.00	4.00	2.61	5.24	5.43	32-10P	7.23	6.72	4.53	7.10	7.99
22-36S	5.24	5.29	3.85	6.42	6.05	32-12S	7.76	7.90	5.48	8.89	9.38
22-36P	4.65	4.65	3.26	5.58	6.02	32-12P	6.86	7.01	4.55	8.05	8.54
22-37S	4.85	4.89	3.29	5.48	5.63	32-13S	10.61	10.72	8.29	11.76	12.29
22-37P	4.00	4.00	2.92	5.24	5.43	32-13P	9.73	9.82	7.16	9.42	11.41
24-1S	4.44	4.35	2.67	5.28	5.59	32-14S	7.80	8.14	5.73	8.69	9.68
24-1P	3.71	4.00	2.57	4.55	5.43	32-14P	6.23	6.72	4.35	7.10	8.09
24-2S	4.89	4.79	3.07	5.43	5.97	32-15S	10.16	10.86	8.44	11.90	12.40
24-2P	4.09	4.29	2.57	4.49	5.48	32-15P	9.33	9.42	7.06	9.62	10.96
24-3S	4.29	4.69	3.01	5.04	5.88	32-16S	10.76	10.86	8.49	11.90	12.44
24-3P	3.80	4.79	3.07	5.43	5.53	32-16P	9.58	9.53	7.16	9.38	11.01
24-4S	4.44	4.79	3.07	5.63	5.97	32-17S	7.65	7.90	5.53	8.64	9.42
24-4P	4.05	4.25	2.57	4.84	5.48	32-17P	6.08	6.32	3.95	7.06	7.90
24-5S	4.69	5.43	4.70	5.39	6.57	32-18S	7.30	7.56	5.02	8.29	8.29
24-5P	5.19	5.63	3.91	5.13	6.86	32-18P	6.96	7.06	4.64	8.09	8.58
24-6S	5.09	4.99	3.31	5.88	6.17	32-19S	7.41	8.00	5.59	8.34	9.33
24-6P	4.35	4.35	2.67	5.04	5.59	32-19P	5.83	6.37	3.95	6.72	7.76
24-7S	5.45	6.27	4.59	5.53	6.57	32-20S	7.93	10.86	8.44	11.90	12.44
24-7P	5.28	6.03	3.76	6.03	7.21	32-20P	9.38	9.42	7.10	9.62	11.01
24-8S	4.93	5.24	4.00	5.77	6.96	36-1S	8.84	9.28	6.99	9.13	10.96
24-8P	3.85	4.09	2.47	4.84	5.39	36-1P	8.20	8.34	5.28	8.64	10.08
						36-2S	7.60	8.29	6.12	9.04	9.97
						36-2P	7.25	7.56	5.33	8.34	9.28
24-11S	6.03	5.92	4.25	6.81	7.16	36-3S	8.44	8.58	6.43	9.77	10.02
24-11P	4.89	5.28	3.56	5.68	6.47	36-3P	7.59	7.80	5.33	8.58	9.42
24-12S	5.04	5.83	4.75	5.77	7.01	36-4S	8.00	8.09	5.92	9.24	9.73
24-12P	4.64	4.79	3.07	5.43	5.97	36-4P	6.72	7.01	4.98	7.80	9.09
24-13S	5.24	5.93	4.21	5.83	6.57	36-5S	7.94	8.09	5.77	8.89	9.57
24-14P	4.00	4.25	2.72	4.79	5.63	36-5P	6.96	7.10	4.84	8.29	8.78
24-15S	4.69	5.43	4.48	5.39	6.67	36-6S	9.42	9.62	7.60	10.76	11.30
24-15P	4.44	4.89	3.26	5.57	6.32	36-6P	8.34	8.75	6.12	9.38	10.27
24-16S	5.28	5.19	3.45	4.69	5.92	36-7S	12.89	10.04	10.81	12.34	14.72
24-16P	4.20	4.55	2.81	4.20	5.04	36-7P	10.26	11.90	8.64	13.09	13.58
24-17S	5.83	6.43	3.16	6.68	6.86	36-8S	9.92	12.48	8.97	11.34	13.72
24-17P	3.80	4.05	2.52	4.59	4.93	36-8P	11.50	11.70	8.78	12.89	13.48
24-18S	4.49	4.44	2.72	5.33	5.63	36-9S	12.60	12.78	10.52	13.97	14.46
24-18P	3.45	3.71	2.17	4.25	5.13	36-9P	9.48	11.01	8.44	12.14	12.49
24-19S	5.83	5.83	3.80	5.48	6.48	36-10S	12.89	10.04	10.81	12.34	14.72
24-19P	4.55	5.04	3.31	5.33	6.27	36-10P	10.26	11.90	8.64	13.09	13.58
24-20S	5.63	5.53	3.80	5.92	6.47	36-11S	12.89	10.04	10.81	12.34	14.72
24-20P	6.12	6.08	4.44	6.61	7.06	36-11P	10.26	11.90	8.64	13.09	13.58

List Prices Shown—Deduct 50% on Black Inserts—40% on Melamine Inserts

24-21S	4.84	4.84	3.45	5.68	5.73	36-12S	12.89	10.04	10.81	12.34	14.72
24-21P	4.59	4.55	3.11	5.04	6.37	36-12P	10.26	11.90	8.64	13.09	13.58
24-22S	5.73	5.63	3.16	5.68	6.86	36-13S	8.58	8.74	6.12	9.93	10.42
24-22P	3.80	4.05	2.52	4.59	5.43	36-13P	7.60	7.76	5.09	8.89	9.01
24-23S	5.73	5.63	3.95	6.57	6.92	36-14S	8.89	10.18	7.45	10.86	11.06
24-23P	6.23	5.63	3.95	6.57	6.92	36-14P	10.12	10.26	7.65	11.16	11.94
24-24S	5.09	5.04	3.31	5.92	6.27	36-16S	12.93	13.09	10.42	12.34	14.72
24-24P	4.35	4.40	2.72	5.04	5.59	36-16P	10.26	11.94	8.64	13.38	13.62
24-25S	5.09	5.04	3.31	5.92	6.27	36-17S	12.93	13.09	10.42	12.34	14.72
24-25P	4.35	4.40	2.72	5.04	5.59	36-17P	10.26	11.94	8.64	13.38	13.62
24-26S	7.30	7.25	5.63	8.84	10.17	36-18S	12.93	13.09	10.42	12.34	14.72
24-28P	9.28	9.18	7.56	9.48	10.22	36-18P	10.92	11.01	8.49	12.29	12.64
24-691S	5.28	5.19	3.45	4.69	5.92	36-19S	11.89	9.04	9.81	11.34	13.72
24-691P	4.20	4.55	2.81	4.20	5.04	36-19P	9.26	10.90	7.64	12.09	12.58
24-835S	5.09	4.99	4.04	1.25	5.88	36-20S	11.89	9.04	9.81	11.34	13.72
24-835P	5.04	4.98	3.25	5.88	6.17	36-20P	9.26	10.90	7.64	12.09	12.58
28-1S	5.77	6.61	4.25	6.57	7.45	36-21S	12.64	12.84	10.17	14.02	14.52
28-1P	5.12	5.43	3.56	6.08	6.43	36-21P	10.92	11.01	8.49	12.29	12.64
28-2S	5.59	6.43	4.09	6.17	7.65	40-1S	12.29	12.49	9.04	13.73	12.93
28-2P	5.24	5.88	3.56	5.88	7.10	40-1P	10.81	11.01	6.57	11.10	11.57
28-3S	5.53	6.77	4.41	6.57	7.90	40-2S	10.32	10.56	8.57	9.90	13.46
28-3P	4.35	4.64	2.52	5.39	6.03	40-2P	9.73	9.88	6.37	11.70	12.29
28-4S	5.09	5.83	3.56	5.88	6.72	40-3S	11.85	12.05	8.73	13.62	14.61
28-4P	4.59	5.24	2.92	5.33	6.23	40-3P	10.61	10.81	7.06	11.80	12.78
28-5S	5.88	6.77	4.60	6.57	7.45	40-4S	12.69	12.93	9.33	14.02	14.61
28-5P	4.89	5.13	2.92	5.88	6.32	40-4P	11.70	11.85	8.14	13.58	14.22
28-6S	6.03	6.03	3.76	6.96	7.36	40-5S	13.88	14.05	10.32	15.80	16.40
28-6P	5.75	6.00	3.07	6.37	7.60	40-5P	12.09	12.34	8.58	13.62	14.21
28-7S	5.33	5.33	3.01	6.17	6.57	40-6S	12.09	12.34	8.78	12.64	13.58
28-7P	4.25	4.49	2.57	5.24	6.12	40-6P	11.21	9.77	7.65	13.13	13.73
28-8S	5.88	6.32	4.00	6.37	7.60	40-7S	12.24	12.44	9.28	13.97	14.56
28-8P	5.13	5.88	3.65	6.08	7.21	40-9P	10.76	15.01	8.26	16.78	17.38
28-9S	6.32	7.25	5.43	7.21	8.64	40-11S	13.04	14.66	10.61	16.44	17.04
28-9P	5.39	5.97	3.77	6.27	7.21	40-11P	11.86	12.05	8.34	13.82	14.42
28-10S	6.47	6.47	4.20	7.41	7.76	40-13S	14.02	14.57	10.66	16.44	17.03
28-10P	5.97	6.08	3.80	6.96	7.36	40-13P	9.73	9.93	6.17	11.76	12.34
28-11S	7.41	8.09	5.83	6.76	9.33	44-1S	14.72	16.54	10.86	15.16	16.54
28-11P	6.32	7.25	4.93	7.06	8.49	44-1P	15.06	15.30	9.38	16.44	15.85
28-12S	6.52	7.80	5.92	7.45	8.84	44-2S	18.37	16.44	10.46	17.18	16.93
28-12P	7.10	7.76	5.48	7.36	9.04	44-2P	13.88	14.42	8.44	14.12	15.65
28-13S	6.52	7.80	5.92	7.45	8.84	44-3S	15.92	12.34	10.46	15.92	16.64
28-13P	7.80	7.80	5.48	6.69	9.09	44-3P	14.52	14.72	8.74	14.52	15.26
28-14S	5.04	5.28	4.35	6.03	7.60	44-4S	18.86	18.37	13.13	18.92	18.81
28-14P	5.77	5.77	3.45	6.67	7.06	44-4P	16.40	16.60	10.46	16.34	17.82
28-15S	6.54	8.78	7.76	9.53	11.76	44-5S	18.86	18.37	13.13	18.92	18.81
28-15P	9.28	9.28	7.01	10.22	10.61	44-5P	15.10	15.30	9.38	16.44	15.85
28-16S	5.77	6.61	5.13	6.67	8.05	44-6S	14.72	16.54	10.92	15.16	16.54
28-16P	4.79	5.28	3.61	5.77	6.37	44-6P	15.06	15.30	9.38	16.44	15.85
28-17S	5.09	5.88	4.44	5.97	7.41	48-1S	15.94	16.29	9.58	19.85	18.46
28-17P	5.43	6.17	3.91	6.17	6.17	48-1P	13.97	14.22	8.20	15.36	16.93
28-18S	6.12	6.37	4.55	7.10	8.14	48-2S	15.94	16.29	9.58	19.85	18.46
28-18P	5.59	5.83	3.71	6.57	6.77	48-2P	13.97	14.22	8.20	15.36	16.93
28-19S	5.33	6.12	3.85	6.12	7.06	48-3S	15.94	16.29	9.58	19.85	18.46
28-19P	4.64	5.39	3.11	5.59	6.61	48-3P	13.97	14.22	8.20	15.36	16.93
28-20S	6.12	6.32	4.99	7.16	8.09	48-4S	15.94	16.29	9.58	19.85	18.46
28-20P	5.48	6.32	4.00	6.27	7.56	48-4P	13.97	14.22	8.20	15.36	16.93
28-21S	10.86	10.86	7.45	11.86	12.14	48-5S	15.94	16.29	9.58	19.85	18.46
28-21P	9.58	9.58	7.16	8.89	10.81	48-5P	13.97	14.22	8.20	15.36	16.93

CABLE CLAMPS — Net Price

3057-3	.30	3057-4	.30	3057-6	.30	3057-8	.35	3057-10	.35
3057-12	.38	3057-16	.40	3057-20	.75	3057-24	.80	3057-28	.85
				3057-32	.95				

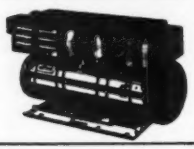
RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey — Phila. 3, Pa.

Telephone Rittenhouse 6-4927

SURPLUS EQUIPMENT

INVERTERS



PE 218 Leland Electric

Output: 115 VAC; Single Phase; PF 90; 350/500 cycle 1500 VA. **Input:** 25-28 VDC; 93 amps; 8000 RPM; Exc. Volts 27.5. **BRAND NEW** .....$39.95 ea.

16086 Leland Electric

Output: 115 VAC; 400 Cycle; 3-Phase; 175 VA; 80 PF. **Input:** 27.5 DC 12.5 amp; Cont. Duty .....$90.00 ea.

PIONEER 12130-3-B

Output: 122.5 VAC; 1.15 amps, 400 cycle single phase, 141 VA. **Input:** 20-30 VDC, 18-12 amps. Voltage and frequency regulated .....$89.50 ea.

10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. .....$80.00 ea.

12116-2-A PIONEER

Output: 115 VAC; 400 cyc; single phase; 45 amp. **Input:** 24 VDC 5 amp...$90.00 ea.

10285 LELAND ELECTRIC

Output: 115 Volts AC, 750 V.A., 3 phase, 400 cycle, .90 PF, and 26 volts, 50 amps, single phase, 400 cycle, .40 PF. **Input:** 27.5 VDC, 60 amps, cont. duty, 6000 RPM, Voltage and Frequency regulated..$195.00

94-32270-A LELAND ELECTRIC

OUTPUT: 115 Volts, 190 V.A., Single Phase; 400 cyc.; .90 PF, and 26 Volts, 60 V.A., 400 cyc., .40 PF. **INPUT:** 27.5 Volts DC, 18 amps; Cont. Duty, Voltage and frequency regulated $95.00

5 RPM GEAR HEAD MOTOR

Mfg. RAE., Type 7519, 115 Volts AD, DC. Fractional HP, Overall dimension: 5⅛" .....$12.95 ea. Lots of 10.....$11.95 ea.

METERS

AMMETER: DC; 2" 100-100, complete with external shunt .....$5.95 ea.
AC Volt. Westinghouse, Type NA-35—3-inch round. F.S.-10 MA.....$6.95 ea.

MICROPOSITIONER

Barber Colman AYLZ 2133-1 Polarized D.C. Relay: Double Coil Differential sensitive; Alnico P.M. Polarized field, 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc.....$12.50 ea.

BLACK & DECKER MOTOR AN 94-32159-A; Volts 24; 1 amp; series wound; 12,000 RPM; 1/75 H.P.; Cont. duty; overall size 5-⅝" x 3" dia..$9.95 ea.

6 RPM GEAR BOX MOTOR

110 Volt, 60 cyc., Single Phase; Ratio—544:1; Mfg. by Merkle-Korff Gear Co., Overall dimensions approx. 3¼" x 3¼" .....$9.95 ea. Lots of 10.....$9.50 ea.

Merkle-Korff 20 RPM motors, 60 cycle, 110 V. AC. .....Like New, $6.95 ea.

Merkle-Korff motor, 24 Volt AC, 60 cycle, CCW Rotation, 110-1 Ratio, 30 RPM $7.95 ea.

Victor Adding Machine Motors geared down to 56 RPM. Have built-in over running clutch; 60 cycle, 110 V. AC, Universal type. Net cost new $35.00...Like New, $12.95 ea.

DELCO FAN—TYPE S.S.P.

115 Volts AC, 50/60 cycle, 6-inch blades, rubber shock mounted. Noiseless, ideal for exhaust and cooling. Complete with mounting as pictured. New, original cartons ....$6.95 ea.

BLOWER ASSEMBLY

115 Volt, 400 Cycle, Westinghouse Type FL, 17CFM, complete with capacitor. New .....$12.50 ea.

G. E. ALTERNATOR

208 Volts, 400 Cycle, 3 Phase Mod. 2CM97B1
55.5 Amps., PF .75, Speed 8000 KW 15, Cont. Duty, Limited Quantity...$320.00

SERVO MOTOR 10047-2-A; 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

PIONEER TORQUE UNITS

TYPE 12604-3-A: Contain CK5 Motor coupled to output shaft through 125:1 gear reduction train. Output shaft coupled to autosyn. follow-up (AY43). Ratio of output shaft to follow-up Autosyn is 15:1 $70.00 ea.
TYPE 12606-1-A: Same as 12604-3-A except it has a 30:1 ratio between output shaft and follow-up Autosyn .....$70.00 ea.
TYPE 12602-1-A: Same as 12606-1-A except it has base mounting type cover for motor and gear train.....$70.00 ea.

400 CYCLE MOTORS

AIRESEARCH: 115V; 40 CPS; Single phase; 6500 RPM; 1.4 amp; Torque 4.8 in. oz.; HP .03 .....$10.00 ea.
EASTERN AIR DEVICES TYPE J36B5: 200 VAC; 1 amp; 3 phase; 400 cycles; 6000 RPM .....$12.50 ea.
EASTERN AIR DEVICES, TYPE J31B: 115 V, 400-1200 Cycle, Single Phase .....$12.50 ea.
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, 2 H.P.; 11,000 RPM; 8 amps .....$79.50 ea.
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, .12 H.P., 6500 RPM; 1.5 amps $25.00
Electric Motor: PNT—1400—A1—1A Serial No. 207, 208 V., 400 cycles, 3 phase, Kearfott Co., Inc. .....$17.50 ea.

SYNCHRONOUS SELSYNS

110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Diehl and Bendix.
Quantities Available
REPEATERS .....$15.00 ea.
TRANSMITTERS .....$15.00 ea.

SYNCHROS

IF Special Repeater (115V-400 Cycle) .....$15.00 ea.
2JIF3 Generator (115V-400 cyc.). .$10.00 ea.
5CT Control Transformer; 90-50 Volt; 60 Cyc. .....$50.00 ea.
5F Motor (115/90 volt—60 cyc.). .$60.00 ea.
5G Generator (115/90 volt—60 cyc.) .....$50.00 ea.
5SDG Differential Generator (90/90 volts —400 cyc.) .....$30.00 ea.
TRANSMITTER, BENDIX C-78246; 115 Volt, 60 Cycle.....$25.00 ea.
REPEATER, BENDIX C-78410; 115 Volt, 60 Cycle .....$37.50 ea.
REPEATER, AC synchronous 115 V., 60 cycle, C-78863 .....$15.00 ea.

ALNICO FIELD MOTORS

(Approx. size overall) . . . 3⅝" x 1¼" diameter)
Delco-Type 5069230: $7.5 volts; DC; 145 RPM $19.95 ea.

POWER RHEOSTATS

Standard Brands: 5 Ohms; 100 Watt; 4.48 amps 100 Ohms; 100 Watt; 1.0 amp.
Boxed, Brand New with Knob $2.50 each — or — $25.00 per Doz.

SMALL DC MOTORS

(Approx. size....4" long x 1¼" dial.)
General Electric Type 5AB10AJ37; 27 volts, DC; .5 amps, 8 oz inches torque; 750 RPM; shunt wound; 4 leads; reversible..$12.50 ea.
General Electric. Mod. 5BA10FJ33; 12 oz. inches torque, 12 V DC, 56 RPM, 1.02 amp. .....$15.00 ea.
General Electric-Type 5BA10AJ52C; 27 volts, DC; .5 amps, 8 oz. inches torque; 145 RPM; shunt wound; 4 leads; reversible .....$12.50 ea.

SENSITIVE ALTIMETERS

Pioneer Sensitive altimeters, 0-35,000 ft. range . . . calibrated in 100's of feet. Barometric setting adjustment. No hook-up required...$12.95 ea.

PIONEER GYRO FLUX GATE AMPLIFIER Type 12076-1-A, complete with tubes .....$27.50 ea.

MOTOR GENERATORS

G.E. Model 5LY77AB1, Input: 115 volts D.C.; 1½ H.P. motor; 13 amp; 3600 RPM; shunt contact regulated. Output: 115 Volts A.C. 60 cycles; KVA .06; shunt self excited. .....$120.00 ea.
MG-183, Input: 70 Volts DC, 5.4 amps., 1/3 H.P., 3500 RPM. Output: 50 Volts AC, 2.6 amps., 175 cycles, 3 phase, .225 KVA. .....$70.00 ea.

PIONEER AUTOSYNS

AY-1..... 26 Volt—400 Cycle..... $6.95
AY-5.....26 Volt—400 Cycle.....$7.95
AY27D $25.50
AY6—26 Volt—400 cyc.....$4.95 ea.
AY30D—26 Volt—400 cyc.....$25.00 ea.
AY14D $14.00
AY34 .....$20.00
AY20—26 Volt—400-cyc. .....$12.50 ea.

AC CONTROL MOTOR

Diehl Mfg. Co., FPE-25-7, 20 Volts, 2 phase, 1600 RPM, .85 amps.....$15.00 ea.

SINE-COSINE GENERATORS

(Resolvers)
Diehl Type FJE-43-9 (Single Phase Rotor). Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Input voltage 115 volts, 400 cycle.....$25.00 ea.
Diehl Type FPE-43-1 same as FJE-43-9 except it supplies maximum stator voltage of 220 volts with 95 volts applied to rotor .....

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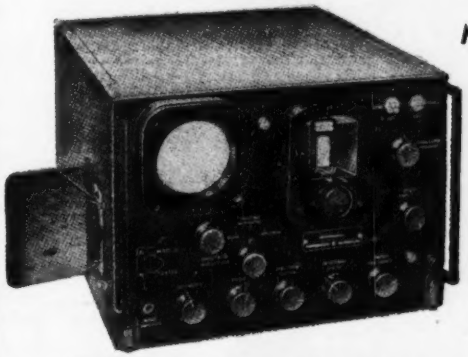

MICROWAVE TEST EQUIPMENT TS148/UP SPECTRUM ANALYZER

Field type X Band Spectrum Analyzer, Band 8430-9580 Megacycles.

Will check Frequency and Operation of various X Band equipment such as Radar Magnetrons, Klystrons, TR Boxes. It will also measure pulse width, c-w spectrum width and Q of resonant cavities. Will also check frequency of signal generators in the X band. Can also be used as frequency modulated Signal Generator etc. Available new complete with all accessories, in carrying case.

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Other test equipment, used checked out, surplus.

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RF4A/AP Phantom Target S Band
TS10/APN Altimeter Test Set
TS12/AP VSWR Test Set for X Band
TS13/AP X Band Signal Generator
TS15/AP Flux Meter
TS16/AP Altimeter Test Set
TS33/AP X Band Power and Frequency Meter
TS34/AP Western El. Synchroscope
TS34A/AP Western El. Synchroscope
T35/AP X Band Signal Generator
TS36/AP X Band Power Meter
TS47/APR 40-400 MC Signal Generator
TS69/AP Frequency Meter 400-1000 MC
TS100 Scope
TS102A/AP Range Calibrator
TS108 Power Load
TS110/AP S Band Echo Box
TS125/AP X Band Power Meter
TS126/AP Synchroscope
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TS175 Signal Generator
TS226 Power Meter
TS251 Range Calibrator APN9
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APS 3 and APS 4 Radar
APR5A Microwave Receiver
APT2 Radar Jamming Transmitter
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BLOWER ASSEMBLY

Lear frame CO10, 5500 rpm motor with 3" Sirroco impeller. Motor 28 v. DC @ 1.2 Amps. Output 10 watts. Cont. duty. **Stock #SA-347 Price $9.75 each.**

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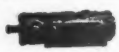
I-82F. Compass Indicator. 0-360°-5 in. dial, 26 v. 400 cy. 8-12 v. 60 cy. Ideal position indicator. Stock #SA-284.

Price $6.50 each

JA1 MOTOR (D-C)

Electric Specialty. ¼ hp. 24 v. D-C. (Wing flap motor.) Stock #SA-325. **Price $19.50 ea.**

OSTER PM MOTOR



Alnico Field

27.5 v. d-c. Can also be used as rate generator. #SA-281. **$8.75 each**

DIEHL PM MOTOR

Type FD6-31-1. 27.5 V. D.C. 10,000 rpm. Dual Shaft. Shaft ext. ⅜" ea. end. Diam. 0.120. Motor 1" Sq. x 2" Lg. Stock #SA-355. **Price $13.25 each.**

800 CYCLE INVERTERS

ECLIPSE Type 800—Model 1, Style D. 24-28 v. DC input @ 62 Amps. 8000 rpm. Output 115 volts 800 cycles single phase, 7.0 Amps. Stock #SA-502. **Price $69.50 each.**

G. E. Type 5AS1211J2, Navy Type CRV-21AAR. 27 v. DC input @ 62 Amps. Output 120 volts 800 cycles single phase at 750 VA. VOLTAGE and FREQUENCY REGULATED. Stock #SA-192. **Price $59.50 each.**

60 CYCLE AMPLIDYNES

G.E. Types 5AM45DB15 and 5AM73AB95. Type 45DB15 input 115 v. 60 cy. at 5 amps. Output 250 volts DC at 0.6 amps. Stock #SA-147.

Type 73AB95 input 115 volts 60 cy. at 9 amps. Output 250 volts DC at 1.5 amps. Stock #SA-257.

PRICES ON REQUEST

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 27.5v d-c 3600 rpm. Cont. duty, 2½" diam. x 5½" lg. ⅝" shaft extension. 5/32" diam. 4 hole base mounting. Stock #SA-34. **Price $19.50 each.**

BLOWER ASSEMBLY

Delco 27 v. DC motor, 5400 rpm. 3" Sirroco impeller. Shunt motor. 4 in./oz. torque. Base Mtg. Stock #SA-352. **Price $9.75 each.**

27.5 VOLT DC MOTOR

John Oster Type E-7-5 4 lead shunt. 1/20th hp. Internal fan cooled 4¾" lg. 3¼" diam. ⅝" shaft extension. 5/16" diam. 3650 rpm. **Stock #SA-31. Price $19.50 each.**

HOLTZER CABOT MG SETS

Type MG-221. Input 32 volts DC at 8.5 amps. 3430 rpm. Output 110 volts at 1.0 amps. 400 cy. Single phase. 100 watts. **Stock #SA-506. Price $99.50 ea.**

Type MG-218. Input 115 volts DC at 2.3 Amps. Output 110 volts 400 cy. Single phase. 100 watts. **Stock #SA-507. Price $119.50 ea.**

BLOWER ASSEMBLY

WESTINGHOUSE FL BLOWER

115 v. 400 cy. 17 c.f.m. Includes capacitor. Stock #SA-144. **Price $14.50 ea.**

Pioneer Servo Motor

Type 10047-2A, 2 ϕ 400 cycle low inertia. 26 v fixed phase. 45 v. max. variable phase. Stock #SA-90. **Price $12.50 each.**

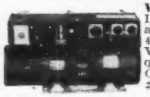
SELSYN SPECIALS

General Electric 2J1F1 & 2J1F3

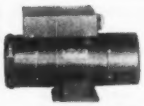
115 v. 400 cycle Selsyn Generator. Large quantity.

Prices on request

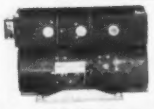
INVERTERS



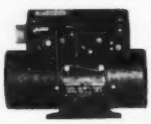
WinchargerPU-7/AP Input 28 VDC at 160 amps. Output 115 v. 400 cy. 1 ϕ at 2500 VA. Voltage and frequency regulated. Cont. duty. Stock #SA-164. **Price $119.50 each.**



G.E. 5AS131NJ3 (PE-118) Input 26 VDC at 100 amps. Output 115 v. 400 cy. 1 ϕ at 1500 VA. PF 0.8 W.E. Spec. KS-5601L1 Stock #SA-386. **Price $39.50 each.**



PE-218EInverters Russell Electric and Leland. Input 28 VDC at 92 amp. Output 115 v. 400 cycles at 1500 VA. PF 0.9. Stock #SA-112A. **Price $69.50 each.**



Pioneer 12130-4-B Input 28 VDC at 14 amps. Output 120 v. 400 cy. single phase at 1.15 amps. (140 VA.) Voltage and frequency regulated. Made 1949. Stock #SA-306. **Price $99.50 each.**

AUTOSYN POWER SUPPLY (CONVERTER)

PIONEER Dwg. 12108-2B. Designed to supply 26 v. 400 cycle excitation to from 50-50 Pioneer Autosyn units. Input voltage 24 v. DC at 3.0 Amps. 4000 rpm. Stock #SA-504. **Price $59.50 each.**

DIEHL DC MOTOR

Type FDE-83-2. 24v @ 9.5 Amps. 1/4 hp. 4350 rpm. Cont. duty. Motor 4¼" diam. x 5" Lg. with 1" shaft ext. x ⅜" dia. front mtg. flange 4½" Sq. Stock #SA-354. **Price $19.50 ea.**

DC MOTOR

John Oster Type A-161-A-2B. 28 v. DC Shunt wound. 8000 rpm. 0.09 oz./in. torque. Large Qty. **Prices on request.**

AUTOSYN MOTOR

Bendix-Marine 851

32 v. 60 cycle excitation. Use as either generator or repeater. Stock #SA-158.

Price $24.50 each.

KOLLSMAN TELETORQUE

Kollsman Type 403 self synchronous units. (Synchro) 115 volt 60 cycle excitation. Use as either generator or repeater. Stock #SA-79.

Prices on request.

115 VOLT D-C MOTOR

G.E. Type SD. 1/20 hp. 4 lead shunt. Reversible. Double shaft extensions. Speed 1725 rpm. **Large Quantity.**

Special $19.50 each.

LEAR POSITIONING MOTOR

Model 156A. 115 watt 24 v. DC motor. 10,000 rpm. Int. duty. Reversible. Dual rt. angle output shaft. Release clutch. 7:1 reduction to output. 250:1 reduction to limit switches. **Stock #SA-343.**

Prices on request

MAGNETIC AMPLIFIER

Pioneer Type 12077

115 V. 400 cy. One Tube Servo Amplifier using saturable reactor type outlet transformer. Limited Quantity

SYNCHROS AND SELSYNS

Navy Types

A; M; 1SF; 5G; 5F; 5SDG; 6SG; 5SF; 5HSF 6DG; 7G; etc.

Army Types

II; IV; V; VII; IX; XXI; XV; etc.

G.E. Types

2J6F2; 2JD5J2; 2J5A2; 2J5HA1; 2J1H1; 2J1F1; 2J1G1; 2J1F3; 2JD5HB1; 2J5LA1; 2JD5C2, etc.

SERIES MOTOR

John Oster Type A-21D-7A

24 v. DC. 0.005 hp. .6 Amps. 11,000 rpm. Cont. duty. 1-½" diam. x 2-⅛" lg. Front flange mtg. Shaft 3/16 dia. x ⅝" ext. Stock #SA-353. **Price $8.75 each.**

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HAYDON TYPE 1600, 4/5 RPM
HAYDON TYPE 1600, 1 RPM
HAYDON TYPE 1600, 1 1/5 RPM
TELECHRON TYPE B3, 2 RPM
TELECHRON TYPE BC, 60 RPM
HOLTZER CABOT, TYPE RBC 2505, 2 RPM, 60 oz. 1 in. torque.

SERVO MOTORS

PIONEER TYPE CK1, 2 ϕ, 400 CYCLE
PIONEER TYPE 10047-2-A, 2 ϕ, 400 CYCLE, with 40:1 reduction gear.

D. C. MOTORS

BODINE NFHG-12, 27 VTS., governor controlled, constant speed 3600 RPM, 1/30 H.P.
DELCO TYPE 5068750, 27 VTS., 160 RPM, built in brake.
DUMORE, TYPE EIY2PB, 24 VTS., 5 AMP., .05 H.P., 200 RPM.
GENERAL ELECTRIC, TYPE 5BA10AJ18D 27 VTS., 110 RPM, 1 oz. 1 ft. torque.
GENERAL ELECTRIC, TYPE 5BA10AJ37C 27 VTS., 250 RPM, 8 oz., 1 in. torque.
BARBER COLMAN ACTUATOR TYPE AYLC 5091, 27 VTS. .7amp., 1 RPM, 500 in. lbs. torque.
WHITE ROGER ACTUATOR TYPE 6905, 12 VT., 1.3 amp. 1½ RPM, 75 in. lbs. torque.

ENGINE HOUR METER

JOHN W. HOBBS, MODEL MI-277 records time up to 1000 hours, and repeats, operates from 20 to 30 volts.

AMPLIDYNE AND MOTOR

AMPLIDYNE, GEN. ELEC. 5AM31NJ18A input 27 vts., at 44 amp. output 60 vts. at 8.8 amp., 530 watts.
MOTOR, GEN. ELEC. 5BA50LJ22, armature 60 vts. at 8.3 amp., field 27 vts. at 2.9 amp. ½ H.P., 4000 RPM.

INVERTERS

WINCHARGER CORP. PU 16/AP, MG750, input 24 vts. 60 amps. output 115 vts., 400 cycle, 6.5 amp., 1 phase.
HOLTZER CABOT, TYPE 149F, input 24 vts. at 36 amps., output 26 vts. at 250 V.A. and 115 vts. at 500 V.A., both 400 cycle, 1 phase.
PIONEER TYPE 12117, input 12 vts., output 26 vts. at 6 V.A., 400 cycle.
PIONEER TYPE 12117, input 24 vts., output 26 vts. at 6 V.A., 400 cycle.
WINCHARGER CORP., PU/7, MG2500 input 24 vts. at 160 amp., output 115 vts. at 21.6 amp., 400 cycle, 1 phase.
GENERAL ELECTRIC, TYPE 5D21NJ3A, input 24 vts. at 35 amps., output 115 vts. at 485 V.A., 400 cycle, 1 phase.
LELAND, PE 218, input 24 vts. at 90 amps. output 115 vts. at 1.5 K.V.A., 400 cycle, 1 phase.
LELAND, TYPE D.A. input 28 vts., at 12 amp. output 115 vts. at 115 V.A., 400 cycle, 3 phase.

PIONEER AUTOSYNS 400 CYCLE

TYPE AY1, AY5, AY14G, AY14D, AY20, AY27D, AY38D, AY54D.
PIONEER AUTOSYN POSITION.
INDICATORS & TRANSMITTERS.
TYPE 5907-17, single, Ind. dial graduated 0 to 360°, 26 vts., 400 cycle.
TYPE 6007-39, dual Ind., dial graduated 0 to 360°, 26 vts., 400 cycle.
TYPE 4550-2-A, Transmitter, 2:1 gear ratio 26 vts., 400 cycle.

VOLTAGE REGULATOR

LELAND ELEC. CO. TYPE B, CARBON PILE. Input 21 to 30 volts D.C. regulated output 18.25 vts. at 5 amp.
WESTERN ELEC. TYPE BC937B, input 110 to 120 volts 400 cycle. Output variation 0 to 7.2 ohms at 3 to 2.75 amps.
WESTERN ELEC. TRANSTAT, input 115 vts., 400 cycle output adjustable from 92 to 115 vts., rating .5 K.V.A.
AMERICAN TRANS. CO., Transtat input 115 vts., 400 cycle output 75 to 120 vts. or 0 to 45 volts, rating .72 K.V.A.

TACHOMETER GENERATOR & INDICATOR

GENERAL ELECTRIC, GEN. TYPE AN5531-1, Pad mounting 3 phase variable frequency output.
GENERAL ELECTRIC, GEN. TYPE AN5531-2, Screw mounting 3 phase variable frequency output.
GENERAL ELECTRIC, IND. 8DJ13AAA, works in conjunction with above generators, range 0 to 3500 RPM.

SYNCHROS

1 F SPECIAL REPEATER 115 vt. 400 cycle.
2J1F1 GENERATOR, 115 vt. 400 cycle.
2J1F3 GENERATOR, 115 vt. 400 cycle.
2J1G1 CONTROL TRANSFORMER 57.5 vt. 400 cycle.
2J1H1 DIFFERENTIAL GEN. 57.5/57.5 vt. 400 cycle.
5G GENERATOR, 115 vt. 60 cycle.
5DG DIFFERENTIAL GEN. 90/90 vts. 60 cycle.
5HCT CONTROL TRAN. 90/55 vts. 60 cycle.
5CT CONTROL TRAN. 90/55 vts. 60 cycle.
5SDG DIFFERENTIAL GEN. 90/90 vts. 400 cycle.

D. C. ALNICO FIELD MOTOR

DIEHL TYPE FD6-23, 27 vts. 10,000 RPM.
DELCO TYPE 5072400, 27 vts. 10,000 RPM.

GENERAL ELECTRIC D. C. SELSYNS

8TJ9-PAB TRANSMITTER 24 VTS.
8TJ11- INDICATOR, dial 0 to 360°, 24 vts.

RECTIFIER POWER SUPPLY

HAMMETT ELECTRIC MFG. CO. MODEL SPS-130 Input voltage 208 or 230 volts, 60 cycle, 3 phase, 21 amps. Output 28 volts at 130 amps. continuous duty, 8 point tap switch, voltmeter ammeter, thermo reset all on front panel.

MISCELLANEOUS

PIONEER MAGNETIC AMPLIFIER ASSEMBLY Saturable reactor type, designed to supply variable voltage to a servo motor such as CK1, CK2, CK5 or 10047.
SPERRY A5 CONTROL UNIT, part No. 644836.
SPERRY A5 AZIMUTH FOLLOW-UP AMPLIFIER part No. 656030.
SPERRY A5 DIRECTIONAL GYRO, part No. 656029, 115 vt. 400 cycle, 3 phase.
SPERRY A5 PILOT DIRECTION INDICATOR, part No. 645262 contains AY 20.
ALLEN CALCULATOR, TYPE C1, TURN & BANK IND., part No. 21500, 28 vts. D. C.
TYPE C1, AUTO-PILOT FORMATION STICK, part No. G1080A3.
PIONEER GYRO FLUX GATE AMPLIFIER, type 12076-1-A, 115 vt. 400 cycle.

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2C6191/K1	2Z9619.99	2Z9638.44	3C317-43
2C6191/T3	2Z9621.43	2Z9643.42	3C317-44
2C6191A/3	9Z9621-112	2Z9647.11	3C323-6C
2C619F/T2	2Z9625-1	2Z9655	3C323-14A
2C6230/193	2Z9625-8	2Z9662	3C323-54B
2C6230.3/194	2Z9626	2Z9709-2	3C323-122B
2C6307/AK1	2Z9627-35	2Z9760	3C323-145B
2C6386A/T14	2Z9628-2	2Z9805	3C324-4
2C6494A/C11	2Z9631.7	2Z9808	3C324-40
2C6530-653A/C10	2Z9631.187	2Z9828	3C343-2
2C6530-653A/T5	2Z9632.8	2Z9851	3C344
2Z3625-66	2Z9631.14	2Z9853	3C344-9
2Z5731-337	2Z9632.39	2Z9854	3C362-8
2Z9600.3	2Z9632.170	2Z9855	3C375-15
2Z9604.16	2Z9632.171	2Z9876-2	3C549
2Z9608.36	2Z9632.248	2Z9878-11	3C573
2Z9611.115	2Z9632.362	2Z9878-13	3C575G-1
2Z9611-289	2Z9632.365	2Z9879	3C362-13
2Z9612.52	2Z9632.366	2Z9879-2	3C362-24
2Z9613.14	2Z9634.4	2Z9879-3	3C1987.20
2Z9613.304	2Z9634.35	2Z9900-5	3C1987-29
2Z9614-94	2Z9634.39	2Z9944	3C4075
2Z9617-22	2Z9634.46	2Z9984	3F4061B/C1
2Z9618-9	2Z9634.49	3C1068	6C8/F1
2Z9618-42	2Z9636.16	3C307-1	
2Z9619.42	2Z9638.14	3C307-46	
2Z9619.63	2Z9638.16	3C317-33	

MORE INFORMATION AND PRICES UPON REQUEST

OIL FILLED CONDENSERS

Stock No.	Capacity MFD.	D.C. WKG. Voltage	Dimensions	Price Each
6057A	2	600	1" x 1-3/4" x 2-3/4"	$0.59
5994A	4	600	1-1/4" x 2-1/2" x 3-1/4"	1.75
5865A	4	1000	1-1/4" x 2-1/2" x 4-3/4"	1.95
6102A	8	1000	1-1/4" x 3-3/4" x 4-3/4"	2.50
6101A	4	1500	1-1/4" x 3-3/4" x 4-1/2"	2.75
6103A	0.5	5000	2-1/4" x 4" x 4-1/2"	2.95
6104A	1	5000	3-5/8" x 4-1/2" x 4-1/8"	4.25
5399A	0.045	16000	1-3/4" x 3-1/2" x 4-3/4"	4.95
6052A	2 X .15	8000	1-3/4" x 3-1/2" x 4-3/4"	4.95

All have ceramic insulated terminals except No. 5865A which has bakelite insulated terminals. All are NEW, standard name brands.

10 MFD. — 600 VDC

Sprague No. R2-157, 10 Mfd. 220 VAC 600 VDC Capacitor with Universal Mounting Ring. 2-7/16" Diameter, 3¾" high. Bakelite insulated terminals.

Stock No. 5658A — Price Each 95¢

SPECIAL PURPOSE TUBES

1B23	7.95	860	2.00
304TL	6.95	872A	3.00
368AS	5.00	874	.79
3E29	9.95	1616	.75
715BY	25.00	1619	.50
724B	3.50	1626	.75
725A	5.95	1629	.75
803	2.95	8020	1.00
811	2.00	8025	3.50
826	.50	3BP1	2.75
837	1.00	5BP1	3.75
838	1.95	5BP4	3.75

2 VOLT BATTERY

Signal Corps Type BB-54A 2 Volt 27 Ampere Hour Storage Battery. Non-Spillable Transparent Acid Proof Plastic Case has Built-in Ball Type Hydrometers. 3" x 4" x 5" High. Shipped Dry with Acid in Separate container. Made by Willard.

Carton of 12 @ $1.60 Each

Stock No. 5458A — Price Each $1.95

INVERTERS

Wincharger PU-7/AP. Input 28VDC at 160 Amps. Output 115V. 400cy. 1 ϕ at 2500VA. Voltage and frequency regulated Cont. duty.

PRICE EACH $95.00

PE-125AX Vibrator power Supply. Input 12 or 24 VDC. Output 500VDC. @ 160Ma.

PRICE EACH $25.00

TRANSMITTING MICAS

Stock No.	Cap.	Test Volts	Type No.	Price Each
5493A*	.01	1000	144S	.35¢
5494A	.02	1000	144T	.40¢
5495A	.006	1200	A2	.44¢
5496A	.001	1500	BE 15	.20¢
5493A	.004	2500	4	30¢
5499A	.001	5000	F	60¢
5680A	.0036	5000	A2	$1.00
5681A	.15	1000V	XS	1.50
5682A	.00007	2500V	3	.90¢
5683A	.00005	3000V	1SL	1.00
5684A	.0001	5000V	F2L	1.00
5685A	.0008	5000V	F21	1.00
5686A	.000025	10,000	PL-34L	1.95
5687A**	.00015	10,000	PL-315	7.95

* Supplied with Meter Bracket
** D.C. Working Voltage
OTHER TYPES AND SIZES AVAILABLE

6.3 VOLT FILAMENT TRANSFORMERS

Primary 115 Volt 60 Cycle 1600 Insulation Three 6.4 Volt Secondaries

6.3 Volts @ 4.9 Amps.
6.3 Volts @ 4.5 Amps.
6.3 Volts @ 1.1 Amps.

Stock No. 5254A

Horizontal Half Shell Mounting. 2¼" x 2 13/16" Mounting Centers. 2 13/16" x 3⅝" Core Size. 2½" above Chassis. Solder Lug Terminals—All Terminals Marked.

Price EACH $2.65

MISCELLANEOUS ITEMS

AIRCRAFT CAMERA K-25 with carrying case $125.00

SCR-522 w/Control Box, Dynamotor PE.-94C and Antennas, new & with all tubes, $95.00 each

BC 659 A&K Receiver and Transmitter, good used $19.95

HEAVY DUTY 10 ft. SJ-7/16 Dia. BUNA CORD, 2 ins. #14 strd Conductors w/heavy duty plug ..... $.60 each

W.E. D163119-A, plug in type Relay $9.95 each

500 ohm AB type J POT, Indiv. Boxed w/set screw knob, used on Control Box C-76/APS-13 ..... $.49 each

SMALL MOTORS

OSTER B9-2. 5600 RPM. 12 VDC @ 1.2 Amps. ..... $7.00 Ea.

OSTER C-2H-1A 7000 RPM. 27.5 VDC 1/100 HP. ..... $7.50 Ea.

KOLLSMAN Type 775-01 Mo-26. $2.50 Ea.

WESTINGHOUSE 115 volt 400 C. Blower. Type FL. 6700 RPM. ..... $6.95 Ea.

MISCELLANEOUS ITEMS

TS-13 Handset $7.95

TS-9 Handset $7.95

T-46 Chestset $1.95

AN-104A Antenna $1.50

BD.57A Switchboards $20.00

J-5 Flameproof keys ..... $.95

J-38 Keys ..... $.95

Fenwal #S1080 Therman Switches.. $3.95

Guardian BK-17A Relay $2.95

MS-52-53 Mast Sections ..... $.95

MP-48A Mast Bases $5.95

2Z 9635-25 ARC/3 Transformer ... $5.00

TERMS:

Open Account to rated or acceptable reference accounts. Others Pre-payment of 25% deposit with order, balance C.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject to prior sale.

ORDER TODAY!

Radio Surplus Corp.

732 South Sherman Street
Chicago 5, Illinois
Phone: HArrison 7-5923

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120DC to 120AC, 60 cy., 1 Ph., Complete with Magnetic Controller, 2 Field Rheos and full set spare parts including spare armatures for generator and motor. New..$295.00
2 KVA O'Keefe and Merritt. 115DC to 120AC, 50 cy., 1 Ph. Export Crated. New.....$195.00
MOTOR GENERATOR, TYPE CGU-2
Unit of U. S. Navy TCK-7 Transmitter
Motor: 3 H.P., 230 V.D.C., 10 amps.
Generator: 1800V. D.C., 0.4 A. 500V. D.C., 0.35A. 115 V. D.C., 1.5A, 12 V. D.C., 2A. 3480 R.P.M. Self excited. Brand new including spare armature $365.00

INVERTERS

Onan M-G.-215H. Navy type PU/12. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 1.2Kw and 26V DC at 4 amps. New.....$295.00
Leland Elec. Co. PE206A. Input: 28DC at 38 Amps. Output: 80V, 800 cy. 1 Ph., 185VA. New..$22.50
G.E. J8169172. Input: 28DC. Output: 115, 400 cy. 1 Ph. 2.5KVA. New.....$32.50
G.E. 5AB13135H1A. Model 21AJ. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5KVA. Regulated. New $89.50
Holtzer-Cabot M.G. 164. Input: 440, 3 Ph., 60 cy., Output: 70V, 144 cy. 3 Ph., 0.140KVA. New $67.50
Elecr. 32DC to 110AC, 60 cy., 1 Ph. at 2.4 Amps. New $39.50

DYNAMOTORS

Navy type CAJO-211444. Input: 105 to 130DC. Output: either 36DC at 20 amps. or 13DC at 40 amps. Radio filtered and complete with line switch. New $89.50
Type PE94CM. For SCR-522. Brand new in overseas cases $19.50

AMPLIDYNES

G.E. 5AM21JJ7. Input: 27VDC. Output: 60VDC. 150 Watts. 4000 RPM. Type MG-27-B. New $34.50
Edison 5AM31NJ18A. Input: 27VDC, 44 Amps. 8300RPM. Output: 80VDC at 8.8 Amps. 550 Watts. New $22.50

SMALL D.C. MOTORS

G.E. 5BA50LJ2A. Armature 27VDC at 8.2 Amps. Field 60VDC at 2.8A. RPM 4000. H.P. 0.5. New $27.50
Oster E-7-S. 27.5DC. 1/20HP, 3800RPM. Shunt Wound. New $9.50
Dumore Co. type ELSG. 24VDC. 40-1 gear ratio. For type B-4 Intervalometer. New.....$8.50

BLOWERS

Westinghouse. Type FL. 115V, 400 cy., 6,700 RPM. Airflow 17C.F.M. New $9.50
E.A.D. Type 350-CW—60 cycle—NEW.....$15.50

SYNCHROS

Ford Inst. Co. Synchro Differential Generator. Mod. 3 Type 58DG. 90/90V. 400 cy., Ord. Dr. 175030. New $22.50
Armor. Synchro Differential Generator. Type 6DG. New $60.00
Hobart Mfg. Co. Synchro Differential Synchro Type XIX 115V. 60 cy. New.....$9.50

PARABOLOIDS

Spun Magnesium dishes 17⅛" dia. 4" deep. Mounting brackets for elevation and azimuth control on rear, 1⅛ x 1⅝" opening in center for dipole. **Brand new, per pair** $12.50

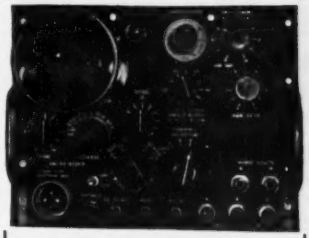
SOUND POWERED CHEST SETS

U. S. Instrument Co. No. A-260 Combination headset and chest microphone. Brand new, including 20 ft. of rubber covered cable.....$17.50 each
W.E. Laboratory Headsets—Type 316 B, 600 ohms at 1000 C.P.S.
Brand new—Price per set.....$6.50

RELAYS

Struthers-Dunn 1BXX129, 110 A.C.....$2.60
Advance type 455C, SPDT, 115 A.C.....$1.95
Leach type 1154A, SPDT, 115 A.C.....$2.35
Leach type 1054, BSN 20-28V D.C.....$2.35
Clare Plug-in base No. 30FMX 115 A.C.....$3.50
G.E. Plug-in base Sensitive K27J853.....$4.50
Western Electric D-163781 Plug-in.....$10.00
Guardian Time Delay type B-9-SPDT.....$2.95
Haydon Time Delay 17717 110V/60.....$4.75

MODEL AN/APA-10 PANORAMIC ADAPTER



Provides 4 Types of Presentation:
(1) Panoramic (2) Aural
(3) Oscilliographic (4) Oscilloscopic
Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 455 kc. 5.2mc or 30mc. With 21 tubes including 3" scope tube. Converted for operation on 115 V. 60 cycle source.
Price **$245.00**
Gov't Cost $1809.00.
AN/APA-10 80 Page Tech Manual.....$2.75

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC.
TS-47APR Test Osc. 40-500MC.
TS-487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets.
RU1A/APR-5A Receiver—1000 to 6000 MC.
AN/APR-4 Tuning Units TN-17 (76-300 MC).
AN/APR-4 Tuning Units TN-18 (300-1000 MC).
AN/APR-4 Tuning Units TN-19 (950-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
AN/APA-10 Panoramic Adapters 115V/60 cycles.

Repair Parts for BC-348 (H, K, L, R only)
Also BC 224 Models F. K., Coils for ant., r.f., det., osc., I.F., c.w. osc., xtal filters, 4 gang cond., front panels, dial assemblies, vol. contls., etc. Write for complete list and free diagram.

HIGH QUALITY CRYSTAL UNITS
Western Electric—(type CR-1A/AR in holders. ½" pin spacing. Ideal for net frequency operation. Available in quantities, 5910-6350-6370-6470-6510-6610-6670-6690-6940-7270-7350-7380-7390-7480-7580-9720. All fundamentals in KC. Good multipliers to higher frequencies .....**$1.25 each**

RADAR

Antenna-Trans-Rec. Unit ASG-1.
Radar Set SQ complete with spares.
Modulator type SO-11.
Pulse Timers CUE-50AGD (SD-5 Radar).
Radar Crystal Units 98.35kc, Raytheon.
1N21B Sylvania Diodes.
Repeater Adapters CRM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit.
CARD 23AEK Bearing Control Units for SO Series.
Auxiliary Rectifier.

RADAR ANTENNAS

Type SO-1 (10CM) assembly with reflector, waveguide nozzle, drive motor, etc. New $279.50
Type SO-3 (3 CM.) Surface Search type with reflector, drive motor, etc., but less plumbing. New in original cases $189.50
Type SO-13 (10CM.) Complete assembly with 21" dish, dipole, drive motor, gearing, etc. New $149.50
Also in stock — spare reflectors, boxsize, probes, right angle bends for SO-1 antennas.

RECTIFIERS

G.E. No. 6 HC89F16 for 54 cells 10 amps.
Mallory APS-50—In: 115/230/60/3. Out: 12/42V-65-130A
Turret Trainer Supply. In: 220/60/3. Out: 28V-130A.
Complete specs. on request.

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat. No. 80G184.
KVA .945/8-.520P Volts 460/345/200/115. New $6.95
FILAMENT—400/2000 CPS. Input—0/75/80/85/105/115/125V. Output—5V3A/5V3A/5V6A/6.3V 0.8A. No. 7249010—New $3.95
PLATE WECO KS 9560 800 cy. Pri: 115V. Sec: 1350-0-1350 at .057A (3700 V. Total). Electat shided. Wt. 2.3 lbs. New.....$2.95
Plate. Thordarson #T45S88. 1650 VA. Pri: 105-120V. 800 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV. insulation. Brand new $49.50
PLATE & FIL. WECO KS9555, 400 cy. Pri: 115V. Sec. #1: 930-0-930. Sec. #2: Three 6.3V windings $4.95
FILAMENT. 400/2400 cps. WECO KS8953. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Electat shielded. Wt. 0.5 lbs. New.....$2.95
PLATE & FIL. 400/2600 cy Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400 VDC at 130MA. Pri. Secs: 6.4V4.8A/6.35V0.8A (Ins. 1500V)/5V2A/5V2A $4.95
RETARD. 400 cy. WECO KS9598. 4 Henry 100MA $2.75

HIGH POT TRANSFORMERS

High Voltage Trans. Westinghouse Pri: 115. 60 cy. Sec: 15 sec. CT on 9V. Good for Hi-Pot test set up. C. T. ungrounded.....**$39.50**

PULSE TRANSFORMERS

PULSE WECO KS-9562 Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000 peak. Wdg. 1-2=18 ohms. Wdg. 1.3=72 ohms. L of Wdg. 1.3=.082H at 100 cps.....$7.50
PULSE. WECO KS-161310. 50 KC to 4MC. 1⅝" Dia. x 1⅞" high, 120 to 3350 ohms. New.....$6.75
High Reactance Trans. G.E. type Y-350ZA.—60 cy. Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8K. Cat. 8318065GI. New $89.50

RAYTHEON VOLTAGE REGULATORS

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V. 60 Watts. ⅛ of 1% Reg. Wt. 20 lbs. 6⅛" H x 8¼" L x 4¾" W. Overload protected. Sturdily constructed. Tropicalized. Special $16.75

AMPLIFIERS

GE Servo type 2CV1C1 400 cycle
Constant Output Line RC-736C
Synchro Amplifiers for Radar
Intercommunication type BC-606

ANTENNAS

MR-162 Coast Guard 23⅛ ft. whips
AS-23 APT-2, AT-38A/APT, AS-62/APR-13
AS-125/APR for APR-5A
TDY RADAR JAMMER HORNS
PARABOLOIDS, MAGNESIUM DISHES 17⅛" dia.
BC-625-A (part of RC-153-B Antenna)
CU 64/APT Antenna matching unit 50 ohm unbal. to 100 bal.

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

LINEAR SAWTOOTH POTENTIOMETER
W.E. KS-15138
Has continuous resistance winding to which 24 volts D.C. is fed to two fixed taps 180° apart. Two rotating brushes 180° apart take off linear sawtooth wave voltage at output. **Brand New....$8.50**

MISCELLANEOUS

Cathode Ray Shields for 5" tube.....$3.75
Variac type Motor Controls 600 watt.....$13.50
10 CM Waveguide 90° elbow.....$29.00
Adel Clamps assorted types—write for samples
Shock Mounts Lord #30.....$.40
Shock Mounts U. S. Rubber #5150C.....$.30
Commando Pole Jacks (Cook Elec. Co.).....$1.00
Switchboard Lamp Receptacles & Jewels.....$.40
SCR522 Transmitter Receivers. Brand New
Fire Detector Wiley motor
No. A-4242. Ord. No. B 257736.....$1.00
Dial Drive Assembly for Bendix. MN-28-Y..$4.50
Instruction Manual for SCR-193A, B, C, D, E $1.50
Solenoid Cannon 24 V.D.C.—New.....$2.50
Attenuators Tech-Lab 500/500 type 700.....$4.75
Volume control Dual for BC-453G.....$2.85
Switch 600V., 60A. Bendix CB13075.....$9.50
Switch Arkless 9 sec. Rotary.....$4.50
Switch Arkless 16 sec. Rotary.....$7.50
Switch Panels RA-2/FRC $12.50
Switch Micro R-ILST .....$.65
Switch Navy Rotary #647491.....$17.50
Contactor CHP-33AG for SO-1 radar.....$24.75
Band-Switch assembly for AR-88 receiver...$9.50
RT7-AN/APN-1 Receivers
RC-423H Modulators
BC-1366M Jack Boxes—Large quantity
Sweep Generator Capacitors 5/10 mfd.....$2.50

HI-VOLT CAPACITORS

.25 Mfd., 20KV.....$26.50
.25 Mfd., 15KV.....$22.50
1 Mfd., 15KV.....$44.50
1 Mfd., 7.5KV.....$12.50
2 Mfd., 6.0KVA.....$14.50
50 KV Capacitors also available various sizes. Write for list.

ELECTRONICRAFT, INC.

27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

INDICATORS

ID-24/ARN-9 .....$12.50
ID-14/APN-1 .....$7.95
ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tube and 80 page Tech. Manual $245.00

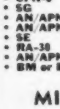
COMMUNICATIONS EQUIPMENT CO.

WANTED
RADAR SETS AND PARTS
. . . . ANY AND ALL TYPES.
Also SURPLUS ELECTRONIC PARTS
. . . . WHAT HAVE YOU TO SELL

RADARS

- AN/APS-2 Airborne S Band Radar
- AN/APS-3 Airborne 3CM Radar
- AN/APS-4 3CM Airborne Radar
- RU/GF Complete Airborne Xmtr-Recvr $99.50
- SO-1 1CCM SEA Radar, 115VDC
- SN 1CCM Portable Radar, 115V, 60Cy.
- PP-4/APQ-2 DC Power Supply from 400 Cy. $5.00
- MK 10 10CM Gun Laying Radar
- MK IV 800MC Gun Laying Radar
- SO-8 10CM Radar 115V DC
- CPN-8 10CM NAV. Beacon, Ground Sta.
- SG 10CM Heavy Duty Ship Radar
- AN/APN-4 Loran Set, Airborne
- AN/APN-3 Sharan, Xmtr. only
- SE 10 cm Surface Search Radar
- RA-38 H.V.P. Power Supply
- AN/APN-7 Airborne Beacon, 10CM.
- BM or BG IFF Sets, 115VAC

MICROWAVE ANTENNA EQUIPMENT



AT49A/APR—Broadband Conical, 300-3300 MC. Type N Feed. (AS SHOWN) $12.50

AS-31/APN-7: 10 cm Polyrod in Lucite Ball. Type N Fitting Coax Feed. $22.50

Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4 ½' x 3'. New $100.00

Dipole for above $12.00

TDY "JAM" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V. AC use. New $450.00

Parabolic Feed. Radiation pattern approx. 25 deg. in horizontal, 33 deg. in vertical planes $35.00

Cone Antenna. AS 125 APR. 1000-3200 mc. Stub supported with type "N" connector $14.50

140-600 mc Directional Antenna

140-310 mc cone and 300-600 mc cone, each consisting of 2 end fed half wave conical sections with enclosed matching stub for reactance changes with changing frequency.
New: complete with mast, guys, cables, carrying chest $49.50

30' SIGNAL CORPS RADIO MASTS

Complete set for erection of a full flat top antenna. Of rugged plymold construction telescoping into 3 ten foot sections for easy stowage and transportation. A perfect set-up for getting out. Supplied complete: 2 complete masts, hardware, shipping crate. Shipping wt. approx. 200 lbs. Sig. Corps No. 2A289-225-A. New ..... $39.50 per set

AS-14A/AP. 10 CM pick up dipole assy. complete w/length of coax and "N" connectors $3.50

AS-66A/APG-4 Yagi Antenna, 8 element array. ..$22.50

30" Parabolic Reflector Spun Aluminum dish $4.85

THERMISTORS

D167018	$1.50
D167332	1.50
D167613	1.50
D168228	1.50
D164699	2.50
D166792	2.15

VARISTORS

D171812	$1.50
D172157	1.50
D167176	1.50
D168687	1.50
D167208E, D171858	1.50
308A, 3A, 27-B	1.50
D168403	2.15

RADAR TRAINER

Bench set designed for training personnel in use of ASB radars, or any sets using "B" presentation. Simulates convoy, ship, land, sea return with adjustable amplitude, range and azimuth. Brand new, in original cases, complete with all cables and instruction book. Prices and additional info on request.

T-4 CHRONOGRAPH HEAD

Consists of RF head, using 723A/B oscillator, 1 trans. antenna, and 1— receiving antenna. All cables used for field testing of projectile velocity. Entire equipment is enclosed in 2 carrying chests. • Write for Price.

MAGNETRONS

Tube	Tube	Tube
2J27	2J49	720BY
2J31	2J61	725-A
2J21	700	730-A
2J32	706	QK 62
2J26	2J62	QK 61
2J39	3J31	QK 60
2J37	5J30	5J56
2J38	718DY	2J32
2J39		

MICROWAVE COMPONENTS

S BAND—3" x 1½" W.G. 10 CM.

DIRECTIONAL COUPLER. Broadband, 20 db. Coupling. Type "N" Takeoff. Complete with all Hardware. Navy + CABV-47A AN/S. Antenna $37.50

WAVEMETER. 2700-3400 MC. Reaction type with counter Dial. Mfg. W. E. $92.50

REACTION WAVEMETER. Mfg. G.E. 3000-4700 MC. Mic. Head $125.00

LMTR. LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG. To Recvr. Less 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCS. Silver Plated $49.50

BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each $47.50

MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated $48.00

RT-39, APG-4 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (2C40, 2C43, 1B27 lineup) w/Tubes $79.50

721A TR BOX complete with tube and tuning plungers. $12.50

McNALLY KLYSTRON CAVITIES for 707B or 2K28. $4.00

F 25/SPR-2 FILTERS, type "N" input and output. Hi-Pass Over 1000 MC $12.50

WAVEGUIDE TO ¾" RIGID COAX — DOORKNOB ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND $12.50

AS14A AP-10 CM Pick up Dipole with "N" Cables. ... $4.50

OAJ ECHO BOX, 10 CM TUNABLE $22.50

HOMEDELL-TO-TYPE "N" Male Adapters, W.E. #D167281 ..... $2.75

I. F. AMP. STRIP: 30 MC, 120 d.b. gain, 2 MC Bandwidth, uses 8AC7's — with video detector. Less tubes $24.50

POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed $22.50

ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC. Type "N" Feed $12.50

"E" or "H" PLANE BENDS. 90 Deg. less flanges $7.50

⅞" RIGID COAX—⅜" I. C.

RIGHT ANGLE BEND, with flexible coax output pickup loop $4.00

SHORT RIGHT ANGLE BEND, with pressurizing nipple $3.00

RIGID COAX per foot, unassembled $3.50

STUB-SUPPORTED RIGID COAX, gold plated 5' lengths. Per length $5.00

RT. ANGLES for above $2.50

RT. ANGLE BEND 15" L. OA $3.50

FLEXIBLE SECTION, 15" L. Male to female $7.75

¾" RIGID COAX. BULKHEAD FEED-THRU $14.00

IMMEDIATE DELIVERY -- FULLY GUARANTEED

X BAND—1" x ½" W.G. 3 CM.

1" x ½" **waveguide** in 5' lengths. UG 39 flange to "UG40 cover ..... **per length $7.50**

Rotating joints supplied either with or without deck mounting. With UG40 flanges ..... **each, $17.50**

Bulkhead Feed-thru Assembly **$15.00**

Pressure Gauge Section 15 lb. gauge and press nipple. **$10.00**

Pressure Gage, 15 lbs. **$2.50**

Dual Oscillator, Mount. (Back to back) with crystal mount, tunable termination attenuator **$16.50**

Directional Coupler, UG-40-U Take off 20 db. **$17.50**

TR-ATR Duplexer section for above **$4.50**

723AB Mixer—Beacon Dual Det. Mnt. w/stal holder **$12.00**

Waveguide Section 12" long choke to cover 45 deg. twist, & 2¼" radius, 90 deg. bend **$7.50**

Twist 90 deg. 5" choke to cover w/pres nipple **$6.50**

Waveguide Section, 24 in. long silver plated with choke flange **$5.75**

Rotary joint choke to choke with deck mounting **$17.50**

3 cm. mitered elbow "E" plane **$12.00**

UG 39 Flanges **$1.50**

90 degree elbows, "E" or "H" plane 2¼" radius **$12.50**

45 degree twist **$8.00**

APS-4 Under Belly Assembly, less tubes **$375.00**

1¼" x ⅝" WAVEGUIDE

CG 98B/APQ 13 12" Flex. Sect. 1¼" x ⅝" O.D. **$10.00**

X Band Wave GD. 1¼" x ⅝" O.D. 1/16" wall aluminum ..... **per ft. 75c**

Slug Tuner Attenuator W.E. guide. Gold plated **$6.50**

Bi-Directional Coupler, Type "N" Takeoff 25 db. coupling **$27.95**

Bi-Directional Coupler, UG-52. Takeoff 25 db. coupling **$24.95**

Waveguide-to-Type "N" Adapter, Broadband **$22.50**

K BAND—½" x ¼" W.G. 1.25 CM.

APS-34 Rotating Joint **$49.50**

Right Angle Bend E or H Plane, speedy combination of couplings desired **$12.00**

45° Bend E or H Plane, choke to cover **$12.00**

Mitered Elbow, cover to cover **$4.00**

TR-ATR-Section. Choke to cover **$4.00**

Flexible Section 1" choke to choke **$5.00**

"S" Curve Choke to cover **$4.50**

Adaptor, round to square cover **$5.00**

Feedback to Parabola Horn with pressurized window . **$37.50**

90° Twist **$10.00**

400 CYCLE TRANSFORMERS

(All Primaries 115V, 400 Cycles)

Stock	Ratings	Price
352-7039	640VCT @ 250MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600 @ 32MA	8.95
12033	4540V/250MA	17.50
K59584	5000V/290MA, 5V/10A	22.50
521652	13,500V/3.5MA	14.65
K59607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V 2.5A, 6.3V/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/75 0V @ .005A	7.45
352-7196	1140V 1.25MA, 2.5V/1.75A, 2.5V/1.75A —5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2X6.3VCT/3A	4.75
RA6400-1	2.5V/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V 9A	2.49
901695-501	2.77V @ 4.25A	3.45
901698-501	900V/75MA, 100V/.04A	4.79
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6440-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80MA, 5V/3A, 6V/1.75A	4.25
3-2-7098	2500V/6MA, 300 VCT, 135MA	5.95
KS-9336	1100V/50MA TAPPED 625V 2.5V/3A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/2IA.	4.25
KS 8944	27V/4.3A, 6.3V/9A, 1.25V/.02A	4.95
52C080	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
37332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
80G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	4.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.95
KS 9685	6.4/7.5A, 6.4V/3.8A, 6.4V/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
95-G-45	2000V/.002A, 465V/.6A, 44V/10A, 6.3V/23.5A, 6.3V/1.8A, 5V/9A, 2X2.5V/1.75A	$7.95
TRANSTAT IN: 115V, 400 CY. OUT: 75-120V, 6.0 Amps		$2.95

PULSE NETWORKS

15A—1-400-50: 15 KV, "A" CKT. 1 microsec. 400 PPS. 50 ohms imp $37.50

G.E. #4053-5-2000-50PT. 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPM 50 ohms impedance ..$6.50

G.E. #3E (3-84-810) (8-2.24-405) 50PT: 3KV "E" CKT Dual Unit: Unit 1, 3 sections, 0.84 Microsec. 810 PPS, 50 ohms imp; Unit 2, 8 sections, 2.24 microsec. 405 PPS, 50 ohms imp. $6.50

7.5E3-1-200-67P. 7.5 KV. "E" Circuit, 1 microsec 200 PPS. 67 ohms impedance 3 sections $7.50

7.5E3-16-60, 67P. 7.5 KV. "E" Circuit, 4 sections 16 Microsec. 60 PPS. 67 ohms impedance $15.00

7.5E3-3-200-6FT, 7.5 KV, "E" Circuit, 3 microsec. 200 PPS. 6 ohms imp. 3 sections $12.50

#755: 10KV. 2.2usec., 375 PPS, 50 ohms imp. ..$27.50

#754: 10KV. 0.85usec., 750 PPS, 50 ohms imp. ..$27.50

PULSE TRANSFORMERS

U-10198 Pri: 4-5KV, 97A Pk Sec; 18KV, 26A. PRR-350-500 Cy. Duration 1.3 usec $45.00

D-166173: Video, Ratio = 50:200 Ohms 10KC—2MC $12.50

G.E.K.-2745 ..... $39.50

G.E.K.-2744-A. 11.5 KV High voltage. 3.2 KV Low voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1 microsec. @ 600 PPS $39.50

W.E. D169271 Hi Volt input pulse Transformer ..$27.50

G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 11KV. Peak power out 100 KW G. E. $34.50

G. E. K2748A. Pulse Input line to magnetron $36.00

Ray UX 7896—Pulse Output Pri. 5v, sec. 41v. ..$7.50

Ray UX 8442 - Pulse inversion -40v + 40v. $7.50

Ray UX 7361 ..... $5.00

PHILCO 352-7250, 352-7251, 352-7287

UTAH 9332, 9278, 9341

RAYTHEON: UX6693, UX5986 ..... $6 ea.

W.E.: D-166310, D-16638, KS 9800, KS9948

PULSE EQUIPMENT

H/1-Volt Pulse Bulkhead. Feed-thru. Fits UG-36 Connector—as shown $15.00

APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk. Pwr out 25 KW Energy 0.018 Joules $49.00

TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KW (1200 KW pk.: pulse rate 200 PPS. 1.5 microsec. pulse line impedance 50 ohms. Circuit series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes $49.50

DELAY LINES

D-168184: 5 microsec. up to 2000 PPS 1800 ohm term $4.00

D-170499: .25/.50/.75 microsec. 8 KV 50 ohms imp. $16.50

D-165997: 1¼ microsec. $7.50

RCA 255686-502. 2.2u sec. 1400 ohms $2.00

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P.O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. — Dept E-10 Chas. Rosen — Phone: DIgby 9-4124

COMMUNICATIONS EQUIPMENT CO.

AIR TRIMMERS

	A Capacity Min. μμf	Capacity Max. μμf	C Fig.	D Shaft Length	E Post Length
	2	12	D	5/16"	3/32"
	2	27	A	1/2"	3/32"
	3	10	D	5/16"	3/32"
	3	18	D	5/16"	1/4"
	4	25	A	17/32"	3/32"
	5	50	A	1/2"	3/32"
	5	55	A	1/2"	3/32"
	7	28	C	5/16"	3/32"
	7	85	D	5/16"	3/32"
	8	45	A	17/32"	3/32"

PRICE, EACH . . . . . 47¢

Fig. A: Round Shaft, Screwdriver Adj. W/Locknut. **Fig. C:** Rd. Shaft, Screwdriver Adj. **Fig. D:** Hex-nut screwdriver Adj.

AUDIO TRANSFORMERS

AT201 50L6 output (4000 ohms) to V.C. (3 ohms) . . . . . $.46

AT SUb Subouncer, Multimatch, 200 ohms to 15 K ohm C.T. and 100 K ohm Grids. . . . . $.69

AT721 H.F. Plate (1800 ohm C.T.) to V.C. (16/4 ohms) 20-15KC $2.29

AT601 HI-Fi Special; PRI: 3000 ohms P-P/Sec: 4/16/32/50/200 ohms 60-10,000 CY.—1 db 50W $3.49

AT152 Hi-Fi Driver Pri: 10,000 ohms Sec: 40,000 ohms PP Grids 50-15 KC/1 db $1.49

AT062 Output to H.S. or line PRI: 16,200 ohms SEC: 8300/600 ohms $1.10

AT449 HI-Fi Driver (3000 ohms), to P.P. output grids (4,000 ohms) 100-10,000 CY, 10W 6V6 to PP 805's $2.19

AT666 Intercon Input: Spkr (4-8 ohms) to grid (250-000 ohms) . . . . . $.69

AT415 Plate (18,000 ohms C.T.) to line (125 ohms) 175 w. 600-600 CY $1.95

AT858 Plate (10,000 ohms C.T.) to line (125 ohms) 125130 ohms) HI-FI—50W $4.95

AT070 Mike-or-Line (250 ohms) to grid (250,000 ohms C.T.) $1.20

AT765 Mike-or-Line (500 ohms to grid (50,000 ohms C.T.) . . . . . $.69

AT-494 HI-FI Output: 3 Watts. 8500 Ohms P-P to V.C. (15 Ohms) 15-15KC PM 1 db. $2.49

AT4-AI: Mike (35 ohms Carbon) to Line 600 ohm/200 ohm $1.19

AT649: Line (500 ohms) to Grid (75K ohms) . . . . . $.89

AT448: Line (600 ohms) to V.C. (8 ohms) 17 d.b. Level $1.19

AT631: Mike-or-Line (200 ohms) to Single or P-P Grids (50K Ohms) . . . . . $.98

AT718 Line (300 ohms) to Line 600/30 Ohm: Response 50-20KC P.M. 1 db. . . . . $.49

RU/GF GEAR

RU/GF XMTR COIL SETS

	PRICE: UNITS
2000-3300 KC	$1.79
3000-3875 KC	each
3675-4525 KC	
6000-7350 KC	
7350-9050 KC	

ACCESSORIES

REMOTE TUNING BOX TYPE.
CW-23012 . . . . . $1.75

XMTR. CONTROL BOX. CW-23097 . . . . . 1.69

RCVR. SWITCH BOX. CW-23098A 1.75

28V DYNAMOTOR & FILTER BOX
FOR RU. 8.95

COMPLETE RU/GF SET WITH ALL PLUGS, MOUNTINGS, XMTR., RCVR., TUNING UNITS, DYNAMOTOR, INSTRUCTION BOOK—READY TO GO—ALL BRAND SPANKING NEW. $97.59

RU/GF COIL SETS SINGLE BAND RCVR

BAND	
L	400- 600 KC
C	545- 850 KC
D	830- 1330 KC
E	1330- 2040 KC
F	2040- 3000 KC
G	3000- 4525 KC
H	4000- 6000 KC
M	5200- 7700 KC
N	6000- 9050 KC
K	9050- 13.375 KC

PRICE: $1.98 EACH

RCVR. DUAL BAND COILS

400-600 KC	6000-9050 KC
540-830 KC	8200-7700 KC
195-290 KC	290- 435 KC
540-830 KC	546- 830 KC

PRICE $2.25 EACH
Schematic of RU/GF Set. 35c

UNIVERSAL SUPPLY KIT

Delivers 230V @ 40MA DC. From 110/220VAC, 60 CY. Kit consists of 1 Transformer, 1—5 HY @ 40MA Choke, 2—8MFD @ 450V Filter Cond, 1—6X5 Tube. A Great Buy at Only **$3.95**

MFRS! MFRS! MFRS! NEW, FINISHED JAN MATERIAL FOR YOUR WAR CONTRACTS
Write! Phone! Wire!

ID-24 ARN-9
Dual 0-200 Microamp. Movement in 3" Case. ILS Equipment $6.95

932 PHOTO TUBE

Gas Phototube having SI Response, particularly sensitive to Red and Near Infrared Radiation. Can be used with incandescent light source. Send for data. Price . . . . . **75¢**

INTERPHONE AMPLIFIER

Easily converted to an ideal inter-Communications set for office, home, or factory. Original. New w/conversion. Diagram **$4.75**

This Month's Special

SUPERSONIC CRYSTALS, Rochelle salt . . . . $.50 ea.
MOTOR, 24 vdc, 3 HP 3800 rpm. New $75.00
TV LEAD-IN WIRE, 300 ohms, HI-Q.
Lo-Loss . . . . . $17.50/M FT Roll
BC 306 ANTENNA TUNING UNIT. NEW 6.95
R9/APN-4, New, With Tubes 75.00
ID6/APN-4, New, With Tubes and Crystal 75.00
A-62 Phantom Antenna 8.50
2 Meter Choke, 1000 MA, 20-144 . . . . . 8/ 1.00
Superocnic Crystal Head, M-I, 22-27KC HI-2 . . . . . 27.45
Underwater Microphone, Model 1R, Z—50Ω 24.50
Dynamic Mike & Headset Combo, B-19, New 3.75
H8-50 Inserts, M-300 . . . . . per M 3.50
AN/ARC-4 VHF Trans-Recv 75.00
PE 36 Test Set, New 37.50
SCR 274 Test Set, I-104 . . . . . 12.25
ART-13 Driver Trans. 6V6 to P-P 811's 1.29
DB 34 Dynamotor, 14V In, 220V, 80 MA out
Sens. Relay: 3.5MA, 13K ohms, 2PST, 2A 1.29
Klixon Breaker: Thermal, 35A 69
T-30 Carbon Mikes, New 89
Tel. Tape, 4" x 0½" Rolls . . . . . 23¢ ea. 5/ 1.00
Tel. Tape, 4" Rolls . . . . . 12¢ ea. 10/ 1.00
BC366 Interphone Jack Box . . . . . .79 ea.
AN/19S-A Antenna . . . . . 1.98 ea.
C-30/ARC-5 Control Box . . . . . 2.35 ea.
EE-89A Telephone Repeater . . . . . 12.50 ea.
EE-65A Telephone Test Set . . . . . 50.00 ea.
ID24/ARN-9 Cross Point Indicator . . . . . 6.95 ea.
TU-8 Tuning Unit 6.2-7.7mc . . . . . 4.95 ea.
BC-496-A Dual Recvr. Con't box, 3-6 & 6-9 Inc . . . . . 1.75 ea.
AN/104-A Antenna, 150mc . . . . . 1.49 ea.
BC704 Indicator, 5" CR Tube, New . . . . . 22.50 ea.
BC929 Indicator, 3BP1, all tubes, New . . . . . 29.50 ea.
Noise Filters, 100 AMP, G.E. . . . . 1.39 ea.
MC211 Right Angle Drives . . . . . .19 ea.
IF Transformers, 112 KC Double Slug Tune . . . . . .69 ea.
IF Transformers, 1600 KC Double Slug . . . . . .79 ea.
MD/7 Modulator for ARC-5, All tubes . . . . . 7.95 ea.
ARC-5 Xmtr. Tuning Cond. #5032 . . . . . 1.49 ea.
ARC-5 Xmtr. M.O. Trimmer #4950 . . . . . 1.29 ea.
Buffer or Osc. Coil, 160 meters, 50W End-Link, 5 pr. STD. Socket, OEL-160 . . . . . .79 ea.
MP 22 MAST BASE $4.95
OSCILLOGRAPH RECORDING, PHOTO PAPER, 35 MM, 250 FT. Roll $1.00

UNIVERSAL POWER XFMR

Pri: Vibrator Input @ 6/12/24/110 VDC. AC Input: 110/220-V @ 60 CY. Sec: 230-0-230 V—40 MA 6.3V—1.8A **$1.49**

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps input

CTJ5-2	600VCT/.2A, 5V/6A			$5.95
CT-15A	350VCT	.085A	6.3V/.6A, 6.3V/1.8A	2.85
CT-164	4200V.002A/12KV Test. 5VCT/3A/12KV Test. 6.3V/0.6A/5400V Test			12.95
CT-341	1060V/10 MA.—625V @ 5 MA. 26V @ 4.5A			
	2x2.5V/5A.		2.5V @ 3A	16.95
CR-825	360VCT	.340A	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160A	2.5/12, 30/.100	9.95
CT-071	110V	.200A	33/.200, 5V/10, 2.5/10	4.95
CT-367	580VCT	.050A	5VCT/3A	2.25
CT-594	2x110VCT	.010A	6.3/1A, 2.5VCT/7A	2.25
CT-403	350VCT	.026A	5V/3A	2.75
CT-931	585VCT	.086A	5V/3A, 6.3V/5A	4.25
CT-610	1250	.002A	2.5V/2.1A, 2.5V/1.75A	4.95
CT-866	330V	.065A	6.3V/1.2, 6.3V/600 MA	1.75
CT-456	390VCT	30MA	6.3V/1.3A, 5V/3A	3.41
CT-160	800VCT	100MA	6.3V/1.2A, 5V/3A	4.95
CT-931	585VCT	85MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75MA	5V/2A, 10VCT/2A, 50V/200MA	3.85
CT-720	550-0-550V/250MA, 6.3V/1.8A			8.95
CT-43A	600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A			6.49
CT-501	650VCT/200MA, 6.3V/4A			6.49
CT-644	230-0-230V/.065A, 5V/3A, 6V/2.5A			3.49

Filament Transformers—115V/50-60 cps input

Item	Rating	Each
FT-674	8.1V/1.5A	$1.10
FT-157	4V/16A,2.5V/1.75A	2.95
FT-181	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V 3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V @ 5A, 29KV Test	24.50

POWER RESISTORS

120W—WW—5% Tol.
1½" Ferrule, 9½" Long

Res.-Ohms	Price	Res.-Ohms	Price
2.5*	55c	195*	35c
25*	35c	225	38c
30	45c	250	35c
32.5	35c	300*	35c
40	31c	450	45c
50*	45c	500*	40c
70*	45c	630*	55c
100	70c	4,500	58c
125	35c	5,000	38c
125*	45c	100,000	65c

* Tapped to give 10 equal sections with 9 tabs.

ELECTROLYTIC CAPACITORS

TWIST PRONG

Cap. Mfd	WVDC	Price
8	450	10.16
30	300	.18
40	450	.38
50	400	.36
60	300	.21
80	150	.29
8-8	450	.24
10-20	25	.16
20-20	150	.23
40-20	300	.21
40-40	150	.28
40-40-20-20	150	.28
40-40-20-20-20	150	.28
40-40-20-20-20-20	150	.32
40/10	450/350	.55
40/20	150/25	.21
40/50	400/300	.28
50/50	450/50	.65
250/1000	10/6	.38
5-5-10	450/25	.26
10-10/10	150/25	.21
10-10/20	450/25	.26
10-15/20	350/25	.18
15-15/10	450/350	.23
30-40/150	400/50	.45
120-60/20	150/25	.45
30-30-15/30	300/50	.29
40-40-20/20	350/15	.28
60-40-20/50	300/25	.28
60-40-20-20/200	150/10	.39
40-40-30/20	150/25	.36
80-40-30/100	150/25	.36
8/8/8	475/100/100	.23
10/50/100	350/100/50	.23
10/50/100	450/100/50	.27
20/20/10/20	350/300/300/25	.35

UPRIGHT OIL CAP.

MFD	Each
	220VAC/600VDC
6.2	$1.29
15	1.49
	330VAC/1000VDC
15	3.79
	1000VDC
.5	.69
.5-.5	1.19
1	1.49
1-1.5	2.19
1.5	1.39
	1500 WVDC
1	1.59
1.5	1.59
2	1.79
	2000 WVDC
1	1.79
	2500 WVDC
.5	2.98
	4000 WVDC
.15	6.95
	4000 WVDC
.1-.1	6.79
	6000 WVDC
.1	3.69
.15-.15	3.89
1.5	10.98
	7000 WVDC
.1-.1	3.79
1	9.95
	8000 WVDC
.075-.075	3.79
	10K VDC
.1	8.95
	15K VDC
.0016	7.95
	15K VDC
.015	9.00
	20K VDC
.25	17.00
	25K VDC
1	85.00
.5	65.00

1 PER CENT PRECISION RESISTORS

ALL VALUES IN OHMS

5	82	150	800	7,500	20,000
5.05	120	250	920	10,000	30,000
10.1	125	430	1100	12,000	35,000
18	128	468	4300	17,000	84,000

30c EACH . . . . . 10 FOR $2.50
100K 250K 500K 2200K
48c EACH . . . . . 10 FOR $3.50
1 MEGOHM . . . . . EACH 75c

DYNAMOTORS

Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set
PE86	28	1.25	250	.060	RC 36
DM41S	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.028	
BD AR 93	28	3.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA9515	12/24	4/2	500	.050	
B-19 pack	12	9.4	275	.110	MARK 11
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-H: Input: 25 28 vdc, 92 amp. Output: 115 v. 350-500 cy 1500 volt-amperes. New
PE-206: Input: 28 vdc, 38 amps. Output: 80 v 800-cy. 500 volt-amps. Dim: 17"x5½"x10½". New . . . $22.50
LELAND #10536: IN: 28 VDC. 12A. OUT: 115V 115VA, 400 CY 3 PHASE. EXC. COND. **$70.00**

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CABLE
CAPACITORS
CERAMICONS
CERAMICS
ADEL & TINNERMAN CLAMPS
CHOKES
COILS
CONTROLS
FILTERS
FUSES
KOVAR GLASS SEALS
RUBBER GROMMETS
HARDWARE
IRON CORE SLUGS
KNOBS
SINE-COSINE POTENTIOMETERS
PULSE TRANSFORMERS
RELAYS
RESISTORS
SERVO TRANSFORMERS
SHOCKMOUNTS
SOCKETS
SPAGHETTI
MICRO SWITCHES
TOGGLE SWITCHES
TRANSFORMERS
TUBES
AND OTHER RADIO & ELECTRONIC PARTS

SENSITIVE SWITCHES

MICROSWITCHES

Type	Contacts	Actuator	Ea
WZR89	Clad	Plunger	.69
M3	Actuator		.49
WZ7RTC	Clad	Pin	.69
WZRQ41	Clad	Plunger	.89
WZ7RQ1T	Clad	Plunger	.97
WZ3RTC	Clad	Pin	.79
WZ3RD1	Clad	Button	.89
WZ7RST1	Clad	Plunger	.79
WT37	Clad	Plunger	.79
YZRQ41	Open	Plunger	.89
YZR31	Open	Pin	.89
APR201	SPDT	Plunger	.89
B15 (Magnet)	Open	Plunger	1.94
BZRW842	SPDT	Leaf	1.79
BZR8	SPDT	Pin	.79

MU SWITCHES

Type	Contacts	Actuator	Ea
DGBP-32	Open	Plunger	1.19
CUM24211	2 ckt	Pin	.79
MGS	2 ckt	Plunger	.89
2A2R	SPDT	Pin	.79

CUTLER HAMMER

A2	Normally Closed	Plunger	.79 ea

CR1070 G.E. SWITCHETTES

No.	Contacts	Ea	No.	Contacts	Ea
C103E3	Open	.69	C130B3	Open	.89
C122A3	Closed	.69	C130D3	Closed	.89
C103F3	2 ckt	.89	C103R3	SPDT	.89

Enclosed Type CR1070D107B3..... Open 1.19

ACRO SWITCHES

Type	Contacts	Actuator	Ea
TD48LSPLL	SPDT	Leaf	1.39
HRC71A2T	Closed	Pin	.69
S1276	Open	Pins (Set of 3)	per set 1.50
XC72L	Closed	Leaf	.69
RD1A	SPDT	Pin	.79

MINIATURE ACRO SWITCHES

Type	Contacts	Actuator	Ea
2MC31A	Closed	Pin	.59
2MD31A	SPDT	Pin	.79
2MD21A	SPDT	Pin	.69

TOGGLE & PUSH SWITCHES

Contacts	Mfgr. & No.	Description	Amps	Each
SPST	Carling	Small Toggle	3A 110V	.15
SPST	C-H	Toggle	6A, 110V	.29
SPST	A, H&H	Toggle	3A, 250V	.29
SPST	C-H B5A	Aircraft	35A, 24V	.29
SPDT	C-H B9A	Aircraft	35A, 24V	.29
SPDT	A, H&H	Toggle	3A, 125V	.29
1 B*	A, H&H	Momentary	5A, 125V	.23
1 B*	T&M Co.	Push	3A, 125V	.29
1 A*	Square D	Push	15A, 24V	.49
SPST	Circle F	Molded Toggle	6A, 125V	.25
DPDT	A, H&H	Molded Toggle	6A, 115V	.69
2Bs	C-H	C6B Aircraft	20A, 125V	.89
3DPT	C-H	8744K7	10A, 250V	1.95
3PST	C-H	8740-K4	10A, 250V	1.29

*1A = SPST n.o. 1B = SPST n.c.

20% off in lots of 100 or more

OIL FILLED CAPACITORS

Many other sizes available at comparative prices. Send us your requirements

BATHTUBS

Mfd.	WVDC	Term	Ea	Mfd.	WVDC	Term	Ea
3x0.1	200	Side	.35	0.5	400	Side	.45
2x0.1	600	Top	.35	2x0.64	600	Side	.45
2x0.1	600	(2)Bot.	.35	1.0	400	Side	.55
2x0.1	600	Bot.	.35	2x1.0	600	(2)Side	.65
3x0 1	600	Bot.	.40	2.0	600	Bot.	.65
0.2	440AC	Side	.40	4.0	50	(1)Side	.65
0.25	600	Top	40	100	25	(2)Side	.65
0.5	600	Bot.	.45	50	25	(1)Side	.30
0 5	600	Top	.42				

CHANNEL

Mfd.	WVDC	Term	Ea	Mfd.	WVDC	Term	Ea
0.015	600	Top	.28	2x0.5	200	(2)Bot.	.35
0.05	1000	Bot.	.35	2x0.5	400	Bot.	.45
2x0.1	600	Bot.	.35	0.5	400	Bot.	.40
3x0.1	400	Bot.	.40	0.5	600	Bot.	.48
3x0.1	600	Bot.	.45	1.0	400	B ot	.48
0.25	1000	Bot.	.40	1.0	400	Top	.48
2x0.25	600	(2)Bot.	.48	1	500	Top	.48

RECTANGULAR

Mfd.	WVDC	Ea	Mfd.	WVDC	Ea
2x0.1	7000	1.89	1.0	2000	1.85
3x0.2	4000	1.95	1.5	330AC	.89
0.2	5000	2.25	2	600	.95
0.25	4000	1.95	5	25	.49
2x0.5	1500	1.49	7	600	1.45
0.75	1000	.69	3x8	5	1.95
1.0	400	.30	17.5	330AC	3.25
1.0	600	.55	Filterette	50V3A	.59
1.0	1500	1.49			

ROUND CANS (Single Terminal)

Mfd.	WVDC	Ea	Mfd.	WVDC	Ea
0.1	3000	2.25	2.0	600	.95
0.25	2500	1.75			

SHOCKMOUNTS

Large Quantities of Lord, Barry, U. S. Rubber and Other Makes of Shockmounts in Stock. Most Sizes Available. Prices Below Manufacturer's Cost. Send Us Your Requirements.

APC TRIMMERS

We Have Production Quantities of 13, 15, 25, 35, 50, 75, 100 and 140 Mmf Air Trimmers Available at Low Prices.

Mu-Metal Laminations

Es, Fs, Is, Ls. Ten Sizes. Quantities Available.

Sample Kit, 6 lbs, Sufficient Quantity of Each Size for One Unit—Post-Paid in U. S. A. $19.75

TERMS—All Prices F.O.B. Our Plant. Rated Firms Net 10 Days: All Others Remittance with Order. Order Under $10 Remittance With Order, Plus Approximate Shipping Charges (overage will be returned.)

115V AC RELAYS

SIGMA 41FZS7; SPDT, 10,000 ohms #R909....$2.95
WARD LEONARD 104-662; DPDT, #992....$3.50
PRICE ELECTRIC Type 1620; DPST N.O. 10 Amp. Contacts....$2.95
RBM #42600; DPST N.O. 10 amp. Contacts....$3.25

H-F TIE POST

Low-Loss Melamine Insulation, pictured actual size (4-40 Thread) ...$7.50/C $67.50/M

SEALED RELAYS

Clare 5001; 24vdc; DPDT; 300 ohm; Octal Plug Base; #R678....$5.95
Struthers-Dunn 181CXC100; 12 vdc; 3As, 2Bs; #R679....$5.95
Sigma 73351; 16vdc; SPDT; 2000 ohm; 8 ma; #R682....$6.95
Allied SKHX, 24VDC; 3A, 3B; 425 ohm; #R913....$5.95
SIGMA Type 4AH; 2000 ohm; SPDT, 4 ma. pull in, 2.5 ma. hold, 5 prong plug-in....$3.95
SIGMA 71257; 6 vac. SPDT, 500 ohms....$4.95
SIGMA 949; 115V AC, SPST N.C....$4.95

Kovar Glass to Metal Seals High-Voltage Feed Thru

Many types and sizes. Send us your blueprint or sample for our quote. Our prices are a fraction of original factory costs.

SAMPLE KIT 96 Seals (8 ea. 12 types) **5.00** postpaid in USA
LAB KIT 300 Seals (20 types) **15.00** postpaid in USA

D.C. SENSITIVE RELAYS

SIGMA Type 4AH; 2000 ohms; SPDT 4 ma. pull in, 2.5 ma. hold, 5 prong plug-in....$3.95
Sigma 41FS7; 2 ma; SPDT; 10,000 ohm; @ #R914....$2.95
Allied FID; 8 ma; 1A; 3000 ohm; #R916....1.50
RBM 23024; 6 ma.; 4PST n.o. (4As); 6500 ohm; #R802....2.95
RBM 23025 6 ma., SPDT, 8000 ohm, #R428....1.50
W.E. (Wheelock) KS80665 9 ma., 1A, 1B, 1C, 2000 ohm, #R426....4.95
Kurman Midget 12 ma., SPDT, 1500 ohm. #R427....98
Clare Type J (K102) 6 ma., SPDT, 3500 ohm, #R30....3.50
Cooke Type C 4 ma., 1A, 6500 ohm, #R506....3.50
B11613 (K1011) 2 ma., SPDT, 6500 ohm, #R588....4.95
Clare A8053 8 ma., 3A, 6500 ohm, #R08....3.95
RBM 452-1041; 4 ma., 12,000 ohm; DPDT; Telephone Type; #R885....4.95
POTTER-BROMFIELD Type LC; 5000 ohms, 5 ma. SPST N.O. #R230....1.50
POTTER-BROMFIELD Type LC; 2560 ohms, 9 ma. SPDT #684....1.50

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Discounts 25-40-60%

24 to 72 hour DELIVERY

"AN" Connectors "AN"

8S1P	14S-14P	18-7S	18-404P	20-24S	22-17P	24-4S	24-710P	28-22S	32-14S	36-13S	40-12P
8S1S	14S-14S	18-8P	18-404S	20-25P	22-17S	24-5P	24-710S	28-410P	32-15P	36-14P	40-12S
10S-2P	16S-1P	18-8S	20-1P	20-25S	22-18P	24-5S	24-835P	28-410S	32-15S	36-14S	40-13P
10S-2S	16S-1S	18-9P	20-1S	20-26P	22-18S	24-6P	24-835S	28-684P	32-16P	36-15P	40-13S
10SL-3P	16-2P	18-9S	20-2P	20-26S	22-19P	24-6S	24-865P	28-684S	32-16S	36-15S	40-14P
10SL-3S	16-2S	18-10P	20-2S	20-27P	22-19S	24-7P	24-865S	28-693P	32-17P	36-16P	40-14S
10SL-4P	16S-3P	10-10S	20-3P	20-27S	22-20P	24-7S	28-1P	28-693S	32-17S	36-16S	44-1P
10SL-4S	16S-3S	18-11P	20-3S	20-28S	22-20S	24-9P	28-1S	28-695P	32-18P	36-17P	44-1S
10SL-656P	16S-4P	18-11S	20-4P	20-28P	22-21P	24-9S	28-2P	28-695S	32-18S	36-17S	44-2P
	16S-4S	18-12P	20-4S	20-29P	22-21S	24-10P	28-2S	28-702P	32-19P	36-18P	44-2S
10SL-656S	16S-5P	18-12S	20-5P	20-29S	22-22P	24-10S	28-3P	28-702S	32-19S	36-18S	44-3P
	16S-5S	18-13P	20-5S	20-30P	22-22S	24-11P	28-3S	28-745P	32-20P	36-19P	44-3S
12S-1P	16S-6P	18-13S	20-6P	20-30S	22-23P	24-11S	28-4P	28-745S	32-20S	36-19S	44-4P
12S-1S	16S-6S	18-14P	20-6S	20-31P	22-23S	24-12P	28-4S	28-766P	32-101P	36-20P	44-4S
12S-2P	16-7P	18-14S	20-7P	20-31S	22-24P	24-12S	28-5P	28-766S	32-101S	36-20S	44-5P
12S-2S	16-7S	18-15P	20-7S	20-32P	22-24S	24-14P	28-5S	28-833P	32-102P	36-21P	44-5S
12S-3P	16S-8P	18-15S	20-8P	20-32S	22-25P	24-14S	28-6P	28-833S	32-102S	36-21S	44-6P
12S-3S	16S-8S	18-16P	20-8S	20-33P	22-25S	24-15P	28-6S	28-840P	32-722P	36-646P	44-6S
12S-4P	16-9P	18-16S	20-9P	20-33S	22-27P	24-15S	28-7P	28-840S	32-722S	36-646S	48-1P
12S-4S	16-9S	18-17P	20-9S	22-1P	22-27S	24-16P	28-7S	28-852P	32-810P	36-697P	48-1S
12-5P	16-10P	18-17S	20-10P	22-1S	22-28P	24-16S	28-8P	28-852S	32-810S	36-697S	48-2P
12-5S	16-10S	18-18P	20-10S	22-2P	22-28S	24-17P	28-8S	28-880P	32-811P	36-795P	48-2S
12S-6P	16-11P	18-18S	20-11P	22-2S	22-29P	24-17S	28-9P	28-880S	32-811S	36-795S	48-3P
12S-6S	16-11S	18-19P	20-11S	22-3P	22-29S	24-18P	28-9S			36-799P	48-3S
14S-1P	16-12P	18-19S	20-12P	22-3S	22-30P	24-18S	28-10P	32-1P	36-1P	36-799S	48-4P
14S-1S	16-12S	18-20P	20-12S	22-4P	22-30S	24-19P	28-10S	32-1S	36-1S	36-853P	48-4S
14S-2P	16-13P	18-20S	20-13P	22-4S	22-31P	24-19S	28-11P	32-2P	36-2P	36-853S	48-5P
14S-2S	16-13S	18-21P	20-13S	22-5P	22-31S	24-20P	28-11S	32-2S	36-2S	40-1P	48-5S
14-3P	16S-14P	18-21S	20-14P	22-5S	22-32P	24-20S	28-12P	32-3P	36-3P	40-1S	3057-3
14-3S	16S-14S	18-22P	20-14S	22-6P	22-32S	24-21P	28-12S	32-3S	36-3S	40-2P	3057-4
14S-4P	16-15P	18-22S	20-15P	22-6S	22-33P	24-21S	28-13P	32-4P	36-4P	40-2S	3057-6
14S-4S	16-15S	18-23P	20-15S	22-8P	22-33S	24-22P	28-13S	32-4S	36-4S	40-3P	3057-8
14S-5P	16-16P	18-23S	20-16P	22-8S	22-34P	24-22S	28-14P	32-5P	36-5P	40-3S	3057-10
14S-5S	16-16S	18-24P	20-16S	22-9P	22-34S	24-23P	28-14S	32-5S	36-5S	40-4P	3057-10-6
14S-6P	16S-17P	18-24S	20-17P	22-9S	22-35P	24-23S	28-15P	32-6P	36-6P	40-4S	3057-12
14S-6S	16S-17S	18-25P	20-17S	22-10P	22-35S	24-24P	28-15S	32-6S	36-6S	40-5P	3057-12-6
14S-7P	18-1P	18-25S	20-18P	22-10S	22-36P	24-24S	28-16P	32-7P	36-7P	40-5S	3057-16
14S-7S	18-1S	18-26P	20-18S	22-11P	22-36S	24-25P	28-16S	32-7S	36-7S	40-6P	3057-20
14S-9P	18-2P	18-26S	20-19P	22-11S	22-37P	24-25S	28-17P	32-8P	36-8P	40-6S	3057-24
14S-9S	18-2S	18-27P	20-19S	22-12P	22-37S	24-26P	28-17S	32-8S	36-8S	40-7P	3057-28
14S-10P	18-3P	18-27S	20-20P	22-12S	22-404P	24-26S	28-18P	32-9P	36-9P	40-7S	3057-32
14S-10S	18-3S	18-28P	20-20S	22-13P	22-404S	24-27P	28-18S	32-9S	36-9S	40-8P	3057-40
14S-11P	18-4P	18-28S	20-21P	22-13S	24-1P	24-27S	28-19P	32-10P	36-10P	40-8S	
14S-11S	18-4S	18-29P	20-21S	22-14P	24-1S	24-28P	28-19S	32-10S	36-10S	40-9P	
14S-12P	18-5P	18-29S	20-22P	22-14S	24-2P	24-28S	28-20P	32-12P	36-11P	40-9S	
14S-12S	18-5S	18-30P	20-22S	22-15P	24-2S	24-684P	28-20S	32-12S	36-11S	40-10P	
14S-13P	18-6P	18-30S	20-23P	22-15S	24-3P	24-684S	28-21P	32-13P	36-12P	40-10S	
14S-13S	18-6S	18-31P	20-23S	22-16P	24-3S	24-691P	28-21S	32-13S	36-12S	40-11P	
	18-7P	18-31S	20-24P	22-16S	24-4P	24-691S	28-22P	32-14P	36-13P	40-11S	

THE ABOVE INSERTS ARE AVAILABLE IN ALL TYPE SHELLS

"AN-3055" — adapters "9760" — cap & chains

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CONDENSERS

MICRO & TOG. SWS. – RELAYS – "J" POTS

OIL CONDENSER SPECIALS

8 mfd.—1000 V.....$3.20
CP70E1EG805K—New Stock. Lots of 10 5% disc., 25 or more 10%.

.1 mfd.—7500 V.....$1.75
Standard Brand #25F475, plus bracket. Carton of 10 10% disc. Quantity disc.

7 mfd.—600 V.....$1.15
Brand new—Dims. 4⅜" x 3⅝" x 3⅛". Bracket.....$.15

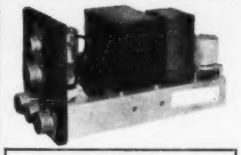
.2 mfd.—1000 V.....$.21
Standard 2 side term. bathtub cond. Same dims. as .25 mfd-600 V type. Exceptional value. Qua. disc.

10 mfd.—600 V.....$.98
Three term. bal. mtg. channel type. Dims. 3⅜" x 3½" x 2". Two 5 mfd. sections rated 400 V at 72 deg. "C". 1800 V test. Meets commercial specs. for 600 V. operation up to 40 degs. "C". Ideal for filter or power factor application. Repeat sales prove this rugged high quality condenser to be of outstanding value. Carton of 24, weight 42 lbs. Large qua. available.....$.89

2 mfd.—1000 V.....$.85
4" x 1¾" x 1" Standard Brand

1 mfd.—600 V.....$.59
Top term. bathtub cond. Type DYR 10% disc. Lots of 100

7 mfd.—800 V.....$1.90
Windings insulated for 1000 V operation. Individually box. Case of 20 10% disc. 2 x 1 mfd—220 VAC (600 DC) 2 ST Bathtub cond. Individually boxed (Qua. disc.)



POWER SUPPLY

#CJP-20ARX for ASB 7/7A/7B equip. 800 cy. 115V. inp. 2.5/5.6/5.8/0-2000V. out. Contains 6AC7, 5T4 & 2X2, plus oil conds.; chokes, resistors, connectors & switches. Brand new and individually boxed. Measures 7"H x 5¾"W x 13"-L. Cover not shown.....$6.75
Lots of 10, 10% disc.; 25, 15%; 50 & over, 25%.

JAN APPROVED

10mfd—1000V 4.55 8mfd—600V 2.25
8mfd—1500V 4.25 6mfd—600V 1.55
8mfd—1000V 3.25 4mfd—600V 1.75

Mfd	Volts	Price	Mfd	Volts	Price
.002			2	1500V	1.65
.005-.01	10KV	4.75	2	2000V	2.80
.01	10KV	3.75	2	2500V	3.10
.012	25KV	19.50	2	3000V	4.69
.02	20KV	18.00	2	4000V	5.65
.03	16KV	Quote	2	5000V	10.95
.075-			2	12,000V	Quote
.075	7.5KV	3.95	2-2	600V	1.25
.08	12.5KV	15.95	3	600V	1.45
.1	1500V	.59	3	5000V	7.95
.1	2000V	.69	3	13.5KV	Quote
.1	2500V	1.20	3-3	500V	.35
.1	3000V	1.75	3-3-3	400V	.75
.1	5000V	3.75	3.75	1000V	1.59
.1	7500V	4.25	4	400V	.85
.1-.1	7500V	6.75	4	600V	1.25
.1	10KV	8.95	4	1000V	1.95
.1	15KV	15.95	4	1500V	2.79
.15-.15	8000V	3.95	4	2000V	4.25
.2	10KV	10.95	4	3000V	7.95
.25	2000V	1.25	4-4-4	600V	2.49
.25	3000V	2.15	5	330VAC	1.75
.25	5000V	3.75	5	600V	2.49
.25	18KV	18.95	5	600V	2.49
.25	20KV	19.95	5	1500V	2.89
.4	10KV	12.95	5-1	600V	2.49
.5	1500V	1.02	6	600V	1.45
.5	2000V	1.19	6	330VAC	2.49
.5	3000V	2.69	6	1000V	2.49
.5	25KV	Quote	6	1500V	3.25
.5-.1	2000V	.89	6	2000V	3.95
.5-.5	600V	.69	7	600V	1.45
.1	400V	.45	7	900V	1.90
.1	500V	.59	7	1000V	2.49
.1	1000V	.69	8	500V	1.45
.1	1500V	1.35	8	600V	1.75
.1	2000V	1.95	8	660VAC	4.25
.1	2500V	2.25	8	1000V	3.20
.1	3000V	3.50	8	1500V	4.25
.1	6KV	7.50	8	2000V	4.95
.1	5000V	4.99	8-8	600V	3.75
.1	10KV	Quote	10	400V	2.50
.1	15KV	Quote	10	1000V	4.55
.1	16KV	Quote	10	6000V	Quote
.1	25KV	Quote	12	600V	2.40
.1-1	7500V	Quote	12	1000V	4.95
.2	600V	.89 .79	14	1000V	5.25
2 TLAD	600V	.88	15	1000V	5.25
	1000V	.99	25Y	600V	4.50
2 TLA	1000V	1.29	24	1500V	8.50

COAX. CONNECTORS

83-1R.....$.45 83-1SPN.....$.39
83-1AP......25 PL-177......50

CHOKES

5 Hen .2 amps 14 Hen .13 amps
2 @ 5 Hen .80 amps 15 Hen .50 amps
7 Hen .57 amps Thord'n T60650
8 Hen .52 amps Thord'n T19C45
12 Hen .10 amps Specially Priced

WANTED
Condensers of all types in any quantity. Also other standard components. Top prices.

TRANS. MICA CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.0001	3000	$0.80	.01	600	.48
.00015	5000	1.75	.01	1200	.55
.0002	15KV	Quote	.01	15KV	Quote
.00025	1200	.35			
.0005	5000	2.25	.0125	6000	5.50
.00025	5000	1.95			
.0004	2500	.23	.02	600	.27
.001	2500	.48	.02	2000	1.15
.001	8000	3.65			
.002	6000	3.50	.03	600	.49
.0024	5000	1.95	Other types available.		
.003	6000	5.95			
.005	1200	.43			

MICA CONDENSERS

5, 6, 8, 10, 15, 25, 30, 34, 39, 50, 70, 75, 100, 140, 150, 185, 200, 230, 240, 250, 300, 350, 390, 400, 470, 500, 510, 600, 650, 700, 750, 1000, 1200, 1250, 1400, 1500, 2000, 2200, 2400, 3000, 3300, 3700, 3900, 4000, 4700, 5000, 5100, 6000, 6200, 6500, 7900, 7950, 7960, 8000, & 9100 mmfd.

PRICE SCHEDULE

5 to 750 mmfd.....5¢
2000 to 5100 mmfd.....11¢
1000 to 1500 mmfd.....7¢
6000 to 8000 mmfd.....12¢

Special Mica Kit—100 @ $3.50

SILVER MICA CONDENSERS

7, 24, 25, 33, 50, 60, 75, 95, 100, 120, 150, 170, 200, 270, 300, 330, 390, 400, 450, 500, 750, 800, 1000, 1400, 1450, 1700, & 2500 mmfd.

7 to 95 mmfd.....8¢
1000 to 1700 mmfd.....14¢
100 to 800 mmfd.....9¢
2500 mmfd.....16¢

Special S.Mica Kit—100 @ $6.50

CERAMICON CONDS.

10, 56 & 100 mmfd @.....05
1000 to 5000 mmfd @.....06
.01 400 V

MOLDED PAPER CONDS.

.01 400 V Type CN35 15¢ ea. $10.50 per "C"
.01, .05, .06 400V. 4¢ ea. $ 3.50 per "C"
.004, .01, .03 600V. 8¢ ea. $ 4.50 per "C"
.1 1000V. 8¢ ea. $ 7.50 per "C"
.01 1000V. 15¢ ea. $13.50 per "C"

AIRCRAFT TOG. SWS.

Aircraft type-20A @ 24VDC-10A @ 125VAC-C=H

CH#	Govt. Spec.	Circuit	Price
8201K4	B-5A	SPST On-Off	
8211K5	B-6B	SPST Off-Mom. On	
8208K4	B-7A	SPST On-Off-Mom. On	
8209K5	B-1B	SPST On-On	
8200K8	AN3022-1B	SPDT On-Off-On	
Plush Mounted-Luminous Tip—Bat. Handle— Price—5.22 ea; $29/100; $170/1000. To get 1000 qua. disc. you may combine types.			

OTHER AIRCRAFT TYPES

Cat.	Circuit	Cur. @ 125VAC	Price
8871K-1	SPST	15A Push but.— Type A2—On-Mom. Off	$.59 P.T.
8905K-514	SP-4PDT	35A @ 24VDC On-Off-Mom. On-Mom. On	.79 L.T.
8905K-526	SPST	5A B-5A-1/4" Bat.	.32 L.T.
8905K-722	3PST	10A Off-Mom. On	.79 L.T.
8911K-524	DPST	15A Push But.-Off-Mom. On	.59 P.T.
8202K-7	SPST	10A 2 Gang B-5A	.32 L.T.

10% Disc. in quan. of 100 pcs. Note per Type

TOGGLE SWITCHES

CH#	Circuit	Price	Amps	Circuit	Price
8800K4	SPDT	$ 60	6A, 125V	DPST	$.42
8824K4	DPDT	75	6A, 125V	DPDT	.50

RELAYS & CONTACTORS

Type	Volt	Ohms	Current	Action	Price
1027	12 Leach	87	5	DPDT	1.35
1077-BFW	24 Leach	160	¼ Cont.	DPDT	1.50
1220-DE	24 Leach	95	20	SPST-Double Break	1.25
1222-BF	24 Leach	160	10	SPST-Double Break	1.25
1227-B2A	24 Leach	140	25	SPST-N.O.	1.25
1232-M	24 Leach	160	10	2-SPST N.O.	1.50
7055	12 Leach	100	50	SPST N.O.	2.50
2791-B100-C3	24 GE	150		DPDT	.98
2791-B100-G3	24GE			DPST N.O.	.95
9350-B7A	24 Sq. D	132	250	SPST N.O.	4.75
6041-H81A	24 CH	65	100	SPST N.O.	2.95
6046-H1A-C1	24 CH	70	30	DPDT	9.95
6046-H1B-C1	24 CH	70	30	DPDT	9.95
6046-H1B-C2	24 CH	70	100	DPDT	11.95
B-9 Time Delay Guard.		500		SPDT	.95
106-A1	115 WL	5	6	DPST	1.50
9340-975	24 Sq. D	500		4 Pole	8.95
Latching Relay					

MICRO SWITCHES

Number	Actuator	Circuit	Term.	Price
WZR-31	Pin	SPST-N.C.	Screw	.49
WZR-31-M	MC2711 Plunger	SPST-N.C.	Screw	.69
M-WZ-8813	Plunger	SPST-N.C.	Screw	.79
WZR-31	HO3-RE11	SPST-N.C.	Screw	1.95
WZ-2YST	Plunger	SPST-N.O.	Screw	.89
WZRQ-41	Plunger	SPST-N.C.	Screw	.89
YZR-31	T-Actuator-LH	SPST-N.O.	Screw	.79
YZ2RDT	Plunger	SPST N.O.	Screw	.69
YZ3RDT	Plunger	SPST N.O.	Screw	.85
YZ-2ST	Plunger	SPST N.O.	Screw	.95
YP3	Ru. on	SPST N.O.	Solder	.49
BZRL2	Roller	SPDT	Solder	.95
BZRHW2T	Roller	SPDT	Screw	1.65
MC-SW(15A 125V)	Lever	DPST N.O.	Solder	1.95

JAN-C-25 Types Available in Quantity SPECIAL CRYSTALS TO YOUR SPECS. 10 DAY DELIVERY—INVESTIGATE 40 CYCLE TRANSFORMERS

352-7061	352-7095	352-7194
352-7066	352-7098	352-7198
352-7068	352-7099	352-7222
352-7070	352-7102	352-7245
352-7085	352-7106	352-7295
352-7851	352-7167	352-1402

YOUR INQUIRIES INVITED

G.E. THYRITE, K8396832-1, 5-40 ma/21-33 volts	$.65
A.E. TYPE #13 STEPPER RELAY, 9-12VDC 3 deck 25 position, 360 degree rotation	8.95
SCR-274N OUTPUT TRANSFORMER, ES-690127	1.65
F-12 MU/METAL LAMINATIONS & #4750 grade, 29 gs.	QUOTE
10 mfd/600 VDC RECT. OIL UPRIGHT, solder lug term.	2.65
HV BARRIER TERMINAL STRIP, 6 term. W/all hwe	.25
RELAY COIL ASSY, 600 ohm 10-50 VDC, W/arm, no cont.	.39
PANEL METERS TO YOUR SPECIFICATIONS — SPECIAL SERVICE	

All Our Material is New—Clean—Ready for Your Use, Factory Type Packaging
FOR FAST INTELLIGENT FRIENDLY SERVICE "CALL ON ESSCO"

ELECTRONIC SPECIALTY SUPPLY CO.

58 WALKER STREET BArclay 7-2684 NYC 13, N. Y.

TYPE "AB" POTS

OHMS	Shaft	OHMS	Shaft
50	1/8 S	20000	1 1/4 & 1/8 LS
60	1/8 LS	25000	3/8 & 1/8 S
150	1/4 S	30000	1/8 S
300	3/8 S	40000	1/8 LS
500	3/8 & 1/8 S	50000	1/4 & 1/8 S
1000	1/8 S	50000	1/8 LS
1500	1/4 S	100000	1/2
2000	1/8 LS & 3/8 S	150000	2 1/8
2500	1/8 S	200000	1/8 LS
3000	1/8 LS	250000	1/8 LS, 9/16
6000	1/4		& 1/8 S
5000	1/8 LS & 3/8	300000	1/8 S
10000	3/8 & 1 1/7	(2 terms.)	
10000	5/16	5 Meg.	1/8 LS
15000	1/8 S	1 Meg.	1/8 S & 1/8 LS

DUAL "AB" POTS

OHMS	SHAFT	OHMS	SHAFT
1500	1/8"	20K	7/16"
1-5 meg	1/2"	1 meg	1½"
		2 meg	1/8 S

BATHTUB CONDS.

Mfd	Volts	Price	M	fd	Volts	Price
.01-.01	600	$.25	.25-.25		600	.49
.02-.02	600	.25	.25		1000	.69
.03	600	.25	.3		400	.45
.05	600	.29	.5		400	.47
.05-.05	600	.29	.5		600	.47
.08-.08	600	.29	.5		1000	.52
.1	600	.29	2x.5		600	.59
.1	1000	.42	1		200	.25
.1	1200	.45	1		300	.39
.1	400	.29	1		400	.45
.1-.1	600	.39	1		600	.59
.1-.1	1000	.51	1-1		600	.75
2x.1	600	.48	2		400	.69
			2		600	.91
.2	1000	.23	4		100	.49

Sp. Bathtub Kit 15 @.....1.00

CHANNEL CONDS.

Mfd	Volts	Price	Mfd	Volts	Price
2x.05	600	.39			
.1	500	.29	.5	400	.21
.1	600	.32			
.1	2500	1.20			
2x.1	400	.44	.5	500	.43
2x.1	600	.48	.5-.1	600	.49
2x.1	600	.48	.5-.5	400	.39
3x.1	1000	.82	.5	600	.49
2x.25	600	.48	.5	1000	.69
2x.25	600	.48	1	500	.58
.4	600	.39	1	600	.63

—SUPER SPECIALS—

Trans. Jefferson #240-151. 230 to 115V. .5KVA Waterproof.	$10.00
S. Mica Cond. 400 mmfd. Per "C"	7.00..
Per "M"	$5.00
Mica Cond. 150 mmfd. Per "C"	4.00..
Per "M"	35.00
Res. 10W 100 ohm WL	.15
Res. 20W 5000 ohm WL	.22
25 mfd-75V Electro's	.15
500 mfd-6V Electro's	.29
Car filter cond. 01 mfd-200V	.07
Socket 7 pin (2ZS169-4)	.01

Write: **ART HANKINS,** *Owner*

MONMOUTH RADIO LABORATORIES

BOX 159 Long Branch 6-5192 OAKHURST, N. J.

Quality • Reliability • Service *PAYS OFF*

WE ARE MOVING TO LARGER QUARTERS

OUR NEW FACILITIES WILL ENABLE US TO DO EVEN BETTER

BATHTUB COND. YAB/T CHANNELS WAB/T

MFD	400V	600V	1000V	400V	600V	1000V
.05	$.30	$.35	$.40	$.35	$.40	$.50
.10	.35	.40	.45	.40	.45	.50
.25	.40	.45	.50	.50	.60	.65
.50	.45	.50	.60	.60	.65	.70
1.0	.50	.65	.75	.75	.85	——
2.0	.90	1.25	——	——	——	——
2 x .05	.35	.40	.45	.40	.45	.60
2 x .10	.40	.45	.50	.45	.50	.65
2 x .25	.45	.55	.65	.50	.65	.75
2 x .50	.55	.65	.85	.60	.75	——
2 x 1.0	.85	.95	——	——	——	——
3 x .05	.40	.45	.50	.45	.50	.65
3 x .10	.40	.45	.65	.45	.50	——
3 x .25	.50	.65	——	.60	.75	——
3 x .50	.60	.85	——	——	——	——

Specify Terminal Layout When Ordering Other Values-Voltages Available

FOR FAST INTELLIGENT FRIENDLY SERVICE "CALL ON ESSCO"

FOR SALE

PLATE TRANSFORMERS

Several hundred new 10 K.W. Amertran oil cooled plate transformers 115 v. 60 cy., 1 phase primary, 17,600 volts, .5 amp secondary. Can be furnished center tapped or two wire 8800 volts, 1.0 amps. Priced $75.00 each f.o.b. Los Angeles. Special Quantity discounts available.

Special Note: These transformers can be seriesed for 220 v. S.P. 2 or 3 wire @ 20 KW with 8800-0-8800 v. sec. or 220 3 ph. @ 60 KW with same sec. voltage output as polarity is additive.

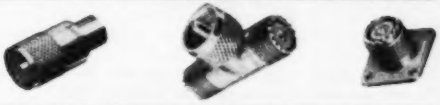
SCR 545-A Radar
New RA-38 15 KV Power Supplies and components

Including 5 v. 10 a. 35 KV test filament transformers. $15.00 ea. and 100 amp, 115 v. transtats $140.00 ea.

EPCO

1527 E. 7th St., Los Angeles, 21, Calif.

YOUR MOST COMPLETE SOURCE OF UHF • UG • AN CONNECTORS



NO.	JAN NO.	DESCRIPTION	1-99	100 TO 999	1000 AND OVER
83-1R	SO 239	RECEPTACLE	$ .50	$ .45	$ .40
83-1SP	PL 259	PLUG	.55	.55	.50
83-168	UG 176/U	ADAPTER	.15	.12	.11
83-185	UG 175/U	ADAPTER	.15	.12	.11
83-1SPN	PL 259A	PLUG	.65	.60	.55
83-776	UG 203/U	PLUG	.65	.60	.55
83-1RTY	....	RECEPTACLE	.75	.65	.65
83-1H	UG 106/U	HOOD	.15	.14	.13
83-1HP	....	HOOD	.27	.24	.22
83-765	UG 177/U	HOOD	.24	.24	.24
83-1AC	... .	CAP & CHAIN	.55	.50	.45
83-1BC	.....	CAP & CHAIN	.35	.31	.30
83-1T	M 358	T CONNECTOR	1.50	1.40	1.40
83-1AP	M 359	ADAPTER	.35	.30	.28
83-1AP	M 359A	ADAPTER	.80	.75	.70
83-1J	PL 258	JUNCTION	.75	.70	.65
83-1F	PL 274	FEED THRU	1.25	1.20	1.10
83-22SP	UG 102/U	TWIN PLUG	.90	.80	.75
83-22R	UG 103/U	RECEPTACLE	.90	.80	.75
83-22AP	UG 104/U	ADAPTER	1.60	1.25	1.10
83-22J	UG 105/U	JUNCTION	1.50	1.40	1.40
83-22T	UG 196/U	T CONNECTOR	1.65	1.50	1.50
83-22F	PL 275	FEED THRU	2.00	1.80	1.75
83-2SP	PL 295	PLUG	2.25	2.15	2.00
83-2R	SO 265	RECEPTACLE	1.65	1.55	1.50

From stock

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
UG 9/U	$ 1.95	UG 57 /U	$ 2.30	CW 155/U	$ .63	UG 254 A/U	$ 3.50	UG 496/U	$ 3.50
UG 10/U	2.75	UG 57 B/U	1.85	UG 155/U	9.50	UG 255/U	2.85	UG 499/U	1.50
UG 11/U	2.25	UG 58 /U	.80	UG 156/U	8.50	UG 256/U	15.50	UG 503/U	50.00
UG 12/U	1.55	UG 58 A/U	1.25	UG 157/U	8.50	UG 257/U	15.50	MX 504	.45
UG 13/U	2.25	UG 59/U	2.45	UG 158/U	47.50	UG 259/U	6.50	UG 505/U	50.00
UG 14/U	1.80	UG 59 A/U	2.15	CW 159/U	1.95	UG 260/U	1.20	UG 506/U	50.00
UG 15/U	1.25	UG 59B/U	2.75	UG 159 A/U	2.20	UG 260 A/U	1.40	UG 507/U	50.00
UG 16/U	2.75	UG 60/U	2.40	UG 160 A/U	2.20	UG 261 /U	1.20	UG 526/U	3.75
UG 17/U	2.75	UG 60 A/U	2.25	UG 160 B/U	2.50	UG 262/U	1.20	UG 530/U	4.50
UG 18/U	1.75	UG 61/U	2.35	UG 166/U	47.50	UG 266/U	4.50	UG 531/U	5.25
UG 18 A/U	1.75	UG 61 A/U	2.40	UG 167/U	5.75	UG 269/U	3.75	UG 532-U	6.95
UG 18 B/U	1.75	UG 83/U	1.95	UG 167 A/U	5.75	UG 270/U	10.00	UG 533/U	10.00
UG 19/U	2.25	UG 85/U	2.00	UG 173/U	.38	UG 271/U	10.00	UG 535/U	4.95
UG 19 A/U	2.25	UG 86/U	2.80	UG 174/U	20.00	UG 272/U	25.00	UG 536/U	2.45
UG 19 B/U	1.95	UG 87/U	1.60	UG 180 A/U	10.00	UG 273/U	2.55	UG 541/U	3.95
UG 20/U	1.95	UG 88/U	1.10	UG 181 A/U	10.00	UG 274/U	3.95	MX 554/U	2.25
UG 20 A/U	1.90	UG 88 B/U	1.95	UG 182 A/U	10.00	UG 275/U	7.50	UG 557/U	5.50
UG 20 B/U	1.90	UG 89/U	1.35	UG 185/U	1.35	UG 276/U	7.50	MX 564/U	.55
UG 21/U	1.25	UG 90/U	1.60	UG 188/U	1.30	UG 279/U	3.95	UG 564/U	3.95
UG 21 A/U	1.95	UG 91 /U	1.95	MX 195/U	1.00	UG 286/U	4.95	UG 565/U	3.95
UG 21 B/U	1.45	UG 91 A/U	1.70	UG 197/U	4.95	UG 287/U	7.75	UG 566/U	7.95
UG 21 C/U	1.75	UG 92/U	1.80	UG 201/U	2.75	UG 290/U	1.20	UG 567/U	6.95
UG 21 D/U	1.95	UG 92 A/U	2.25	UG 202/U	3.95	UG 291/U	1.25	UG 568/U	4.95
UG 22/U	1.65	UG 93/U	1.95	UG 204 A/U	2.50	UG 294/U	2.20	UG 569/U	2.95
UG 22 A/U	1.60	UG 93 A/U	2.25	UG 206/U	2.00	UG 299/U	7.75	UG 570/U	2.95
UG 22 B/U	1.50	UG 94/U	2.25	UG 207/U	25.00	UG 306/U	2.95	UG 571/U	6.95
UG 22 C/U	1.95	UG 94 A/U	1.60	UG 208/U	22.50	UG 309/U	3.75	UG 572/U	5.95
UG 23/U	1.65	UG 95/U	1.95	UG 212 A/U	3.50	UG 332/U	2.50	UG 573/U	7.25
UG 23 A/U	1.95	UG 95 A/U	2.00	UG 213 A/U	4.10	UG 333/U	5.50	UG 602/U	3.00
UG 23 B/U	1.75	UG 96/U	2.10	UG 215/U	5.50	UG 334/U	6.50	UG 603/U	3.00
UG 23 C/U	1.95	UG 96 A/U	1.95	UG 216/U	14.00	UG 335/U	3.75	UG 625/U	1.70
UG 27 A/U	3.75	UG 97/U	4.25	UG 217/U	7.50	UG 347/U	2.50	UG 627/U	7.25
UG 27 B/U	3.75	UG 97 A/U	3.95	UG 218/U	10.00	UG 348/U	1.50	UG 628/U	7.25
UG 27C/U	4.50	UG 98/U	2.50	UG 219/U	7.50	UG 349/U	3.50	UG 634/U	4.95
UG 28/U	3.95	UG 98 A/U	2.70	UG 220/U	10.00	UG 352/U	7.50	MX 913/U	.65
UG 28 A/U	3.95	UG 100/U	2.95	UG 222/U	42.75	UG 352A/U	9.00	UG 931/U	3.00
UG 28 B/U	4.50	UG 100 A/U	3.75	UG 223/U	6.50	MT 419	.95	UG 932/U	3.00
UG 29/U	1.00	UG 101/U	4.45	UG 224/U	1.20	UG 414/U	2.95		
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UG 29 B/U	1.90	UG 107 A/U	4.50	UG 233/U	18.50	UG 421/U	3.25		
UG 30/U	2.50	UG 107 B/U	4.50	UG 234/U	18.50	UG 422/U	3.25		
UG 32/U	19.00	UG 108/U	2.90	UG 235/U	35.50	UG 423/U	5.80		
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UG 36/U	19.00	UG 110/U	15.00	UG 242/U	3.95	UG 482/U	33.80		
UG 37/U	19.00	UG 114/U	2.15	UG 243/U	4.50	UG 483/U	4.65		
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UG 46/U	5.00	UG 148 A/U	7.85	UG 251/U	18.50	UG 493/U	7.25		
UG 49/U	20.00	UG 149 A/U	5.25	UG 252/U	7.50	UG 494/U	4.75		
UG 50/U	20.00	UG 154/U	9.50	UG 253/U	5.50	UG 495/U	7.50		

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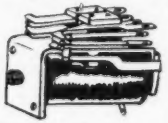

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10Y	.45	957		.40	RKR-72	1.15
15R	.70	CK1005		.50	RK-73	.60
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T-17 Mike	4.95
Scope Transformer PRI—110 v Sec. 4000 v at 10 MA	3.95
A-5 Automatic Pilot directional Gyro—New	19.95

20% Deposit with Order, Balance C.O.D. Michigan Residents Add 3% Sales Tax.

HERSHEL RADIO CO.

5245 Grand River Avenue
DETROIT 8 MICHIGAN

WAREHOUSE CLEARANCE TUBE SALE

NEW, STANDARD MANUFACTURERS, IMMEDIATE DELIVERY

0B3/VR90	$1.20	5JP2	$19.50	464A	$ 9.50	8020	$ 2.50
0C3/VR105	1.20	5T4	1.50	531	14.50	9001	1.75
0D3/VR150	.85	6AC7	.95	532A/1B32	3.95	9002	1.50
1A3	.85	6AG7	1.20	706A	3.75	9003	1.75
1A5GT	.75	6AJ5	2.25	706AB	22.50	9004	1.75
1B22	3.75	6AJ6	2.10	706AY-GY	32.50	9006	.75
1B24	14.95	6B6G	.75	707A	14.50	CE22/918	1.50
1B27	17.50	6C6	.79	721A	2.45	CK501LX	1.50
1B32/532A	3.95	6C8G	.79	723AB	22.50	CK1089	1.50
1N21	1.25	6H6	.69	724A	2.95	EL5B/4B22	9.75
1N22	1.25	6K7	.75	724B	8.95	ELC5B	9.75
1N23	1.50	6SA7	.74	726A	14.95	ELC6A	7.50
1N27	2.95	6SC7	.97	750TL	79.50	EL6CF	8.95
1P23/CK-1	3.50	6SH7GT	.79	801	.85	EL302.5/3B21	4.50
1R4/1294	.85	6SH7	.79	803	5.95		
1T4	.59	7C4/1203A	.75	804	10.50		
2A3	.95	7E5/1201	.95	805	4.95		
2AP1	8.95	7E6	.85	807	1.79		
2B22	4.25	10Y	1.50	810	10.95		
2C33/RX233A	3.45	12A6	.85	811	2.85		
2C40	17.50	12C8	.89	813	8.95		
2E22	3.49	12H6	.69	814	3.35		
2J21	9.95	12J5GT	.67	815	3.40		
2J21A	12.95	12SF7	.75	816	1.45		
2J22	14.95	12SJ7GT	.65	826	1.39		
2J27	22.50	14H7	.97	830B	2.95		
2J34	38.45	14J7	1.10	832	7.95		
2J50	69.50	15R	1.00	832A	9.50		
2J55	98.00	23D4	.85	836	4.50		
2X2	.89	30	.48	838	3.50		
2X2A	2.15	45	.35	838W	6.50		
3A4	.65	53A	3.95	845	8.95		
3B7/1291	.62	71A	.89	845W	6.95		
3B24	5.50	76	.55	866A	1.25		
3C23	10.50	77	.65	872A	3.65		
3C24/24G	1.95	78	.80	884	1.79		
3DP1	3.95	100TH	10.50	902P1	7.50		
3D6/1299	.62	112A	.40	927	.45		
3EP1	4.95	211	1.25	958	.60		
3FP7	4.50	227A	4.50	959	1.50		
3GP1	4.75	274B	2.95	991/ME16	.25		
3JP12	14.50	304TH	13.95	1616	2.95		
4B22/EL5B	9.75	304TL	19.50	1619	.89		
4B28/EL6CF	8.95	350A	6.95	1624	1.95		
4J36	175.00	388A	2.50	1625	2.00		
4J37	175.00	371B	2.95	1629	2.00		
5BP1	5.95	388A	2.95	1655/6SC7	.97		
5B21	23.95	394A	4.25	1846	115.00		
5FP7	2.50	450TH	44.50	2051	.95		
5JP1	23.50	450TL	44.50	8005	5.85		

BRAND NEW! EXCLUSIVE 3600V @ 520 Ma. PLATE TRANSFORMER

REG. $125 **$49.50**

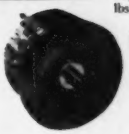
Thordarson plate transformer in gray steel potted case. Supplies 3600V @ 520 ma. with three 866A rectifiers. Pri. 208/230V Delta conn. to 1890V, ½ phase, Sec. 3280V AC. Input: VA 2270. 19½ x 15 x 8". Wt. 150 lbs. Order No. T-254

RADIO SHACK

CORPORATION

167 Washington St., Boston 8, Mass.

FG27A	$ 8.95
FG-90	6.50
GL-316A	3.40
GL-434A	22.50
GL446A	2.50
GL-805	49.95
ML-531	14.50
QK-59	85.00
QK-60	85.00
QK-61	85.00
QK-72	85.00
RK-28	3.69
RK-65	26.50
RK-72/CRP72	1.95
RX21	3.85
RX233A/2C33	3.45
VR-90	1.20
VR-105	1.20
VR-150	.85
VT-127A	2.95
WL-417A	22.50
WL-653B	75.00
ZP-653	68.00



BRAND NEW! 8 WATT PRECISION RHEOSTAT

REG. $5.00 ONLY **$1.50**

10 for $12.50 100 for $100

Save $3.50! New, boxed model 260. 20K ohms. Linearity accuracy 1%; tot. resistance accuracy 5%. Max. current 20 ma, 8W rating. Angle of rot. 294° Inside contact arm, 4 separate wiping fingers. 3 x 1½", ¾ x ½" shaft. Can be ganged. Order No. R-5262

QUARTZ CRYSTALS

NEW LISTING

Made from the finest Brazilian Quartz. Will provide a high degree of activity and frequency stability. All tested and marked by the manufacturer to a very close tolerance. In the frequencies outlined below the crystals itemized under the heading "From & To" are mostly in progressive frequencies between the limits shown (as for example: "From 3300 to 3377," are as follows: 3300KC, 3301KC, 3302KC—, 3377KC.) are of limited quantities in each frequency. Those listed singly are in quantities of 50 or more.

FT243

Prong centers ½", Prong dia. 3/32"

Price $1.15 ea. (25 for $25.00)

FROM	TO	FROM	TO	FROM	TO
1515	1915	4225		6000	
1520	2065	4250		6025	
2125	2155	4275		6050	
2300			6292	6100	8175
2325	2390	6180	6375	6225	8275
2430	2490	6400	6498	6300	8375
2500		6450		6350	
2605		6506.6	6675	6400	8475
2615	2685	6550	6775	6425	8575
2725	2799	6600	6875	6500	8650
2805	2833	6615		6706.25	
	2865	6650		6850.25	
4164	4190	6900	6975	6874.25	
4184	4250	6975.75		6975.25	
4205	4257	7225	7285	9135.0	
4225	4250	7275	9362		9299
4000	4039	7450.75	9465		9499
4041	4059		9500		
4061	4095	7460	7475		9589
4080	5195	7496	7675.5	9600	9638
5200	5397.5	7500		10075	
5400		7550		12600	12698
5500		7600		12700	12798
5600		7700		12800	12898
5613.5		7720		12900	12998
5616.5		7725.8		12905	12995
5677.7		7750		13000	13099
5700		7751.25		13100	13199
5706.6	5775	7773.75		13200	13299
5722.2			7790	13301	13351
5744.4		7800		13400	13496
5800	5892	7825		13500	13596
5900	5975	7850		13597	13697
6000		7875		13901	13996
6050	6075	7900		14000	14098
6086.6		7925		14110	14198
6150		7950			
6175		7975			
6180	6173.3	7986	7968		

CR 1A/AR or FT241

Prong spacing ½", Prong dia ⅛"

Price 79¢ ea. 12 for $9.00

FROM	TO	FROM	TO
(Frequencies in KC)		(Frequencies in KC)	
2853		7620	
2868		7650	
2885		7680	
4285		7740	
4300	4374	7760	
4788		7780	
4820	5090	7790	
5020		7795	
5090	5180	7798	
5120	5200	7820	
5180	5296	7830	
5260		7840	
5290	5396	7850	
5410		7860	
5600		7870	
5660	5788	7880	
5810		7900	7980
5860		7910	
5910		7925	
5940	5968	7940	
6000	6080	7960	
6050	6195	7970	
6230	6375	7975	
6270	6375	7990	
6370	6499	8002	8010
6400		8007	
6480	6598	8012	
6500	6645		8052
6744		8285	8298
6760	6877	8340	
6905	6988	8380	8370
7000		8400	
7038		8412	
7060		8460	8498
7080		8506	8545
7540		8545	
7545.6		8580	8650
7560		8965	
7600		11677	

XL5 Dual

3 prongs ½" X 1 19/32" prong dia.

Price $1.95 ea.

2520 A 2680
2731 A 2895
2450 A 2575
3138 A 3153
2605 A 2753

XL5 Single

3 prongs ½" X 1 19/32" prong dia.

Price $1.35 ea.

FROM	TO
2200	2258
2300	2345
2410	2480
2565	
2600	2808
2702	2782
2802	2895
2910	
3127	3175
3154	
3175	3375
3435	
3827	

FT241A

SPECIAL TYPE WE.
Prong spacing 1" CTS.
Prong Size 3/32" dia.

These are in successive steps of .1 MC variation from 20.0 MC to 27.9 MC.

Suitable for low frequency purposes (1/54 of Stated Values)

Price $1.15 ea.

UNASSEMBLED CRYSTALS

consists of quartz crystal plates made for FT243 holders. Furnished complete with holders, electrodes, springs and all hardware.

Price .29 ea.

Crystal plates available in the following frequencies:—

7533	7750	7873	8475
7545		7900	8750
7590	7775	8275	
7640	7800	8325	
7680	7825	8450	
7700	7850		

EDLIE ELECTRONICS, Inc.

154 Greenwich Street, New York, N. Y.
Telephone Digby 9-3143

TUBES

We guarantee all tubes. We endeavor to give you low, low prices, consistent with quality merchandise and service. Stock Up Now.

0A2	$ .98	6AG7	1.45	373-A(WE)	5.00
0B2	1.10	6AJ5	1.90	374-A(WE)	4.00
0Z4	.59	6AK5	.75	387-A(WE)	2.50
1AX4	1.10	6AK6	.90	408-A(WE)	2.50
1B22	2.00	6ANS	1.75	403-A(WE)	5.50
1B23	8.00	6B8	.65	403-B(WE)	7.50
1LA	.59	6C4	.45	407-A(WE)	5.00
1L2I	4.00	6F6-M	1.80	408-A(WE)	2.75
1N21-B	1.45	6F8-G	.88	GL-559	1.00
1N23-A	2.45	6G6-G	.95	KU-676	25.00
1N23-B	3.75	6J5	.49	700-D	55.00
1N31	5.50	6J6	.59	715-C	20.00
1N34	.64	6J7	.75	717-A	.98
1N34-A	.85	6K7	.70	803	3.50
1N44/400-B	1.75	6L6-G	.49	805	2.50
1N45-400-C	1.35	6L6-G	1.19	807	1.59
1N54	.89	6L7	.98	811-A	3.50
2C39	29.95	6S7	.98	837	1.45
2C43(G.E.)	15.95	6SD7	.79	838	2.25
2C52	5.50	6SG7	.88	860	3.95
2D21	1.35	6SK7-GT	.60	861	22.50
2E24	2.75	6SL7-GT	.60	866-A	1.55
2E30	2.15	6SN7-GT	.65	872-A(G.E.)	3.50
2J38	65.00	6V6-M	1.10	CK-1005	.48
2J34	27.50	6Y6-G	.95	1616	.74
2J49	34.50	7C38	85.00	1619	.38
2K45	85.00	7H7	.88	1622(GL6M)	1.95
3B28	7.50	12A6	.65	1625	.40
3B29	12.00	12C8	.79	1629	.38
3BP1	5.75	12AH7-GT	1.10	1631	1.50
3BP11	10.00	12AU7	.60	1632	.70
3C27	7.50	12SF5	.70	2050	1.45
3C33	9.95	12SG7	.87	2051	1.19
3E29	10.95	12SH7	.65	5516	6.95
3Q5	.99	12SJ7	.65	5686-A	3.95
4C35	26.50	12SR7	.70	5654	2.00
4X150A	37.50	FG-105	19.50	5814	4.50
5BP1	1.50	21A	.70	5910	.75
5BP4	4.00	274-A(WE)	3.50	8020	.98
5CP1	3.00	274-B(WE)	2.25	9001	1.15
5FP7	1.95	276-F and G	15.00	9003	1.15
6BH6GY	1.00	304-TH	7.00	9004	.39
6U4-G	.59	304-TL	8.00	9006	.39
6X4-G	.85	310-A(WE)	5.95	CGL/5528	15.00
6Y3-GT	.95	311-A(WE)	6.50	F-123-A	6.95
6Z3	.85	350-B(WE)	4.95	RK-72	.75
6AB7	.95	359-A(WE)	4.00	RK-73	.75
6AC7	.50	371-B	.85		

WRITE ON TYPES NOT LISTED

Top Dollar Paid for SURPLUS TUBES & EQUIPMENT — Send List With Details

SELENIUM RECTIFIERS

Full-Wave Bridge Types

Current (Continuous)	18/24 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp.	$1.25	$2.20	$3.60	$7.50
2 Amps.	2.20	3.60	6.50	10.50
2½ Amps.				13.00
4 Amps.	3.75	6.75	8.75	
5 Amps.	4.95	7.95	12.95	27.00
6 Amps.	5.50	9.00	14.00	33.00
10 Amps.	6.75	12.00	20.00	48.00
12 Amps.	8.50	16.00	25.00	60.00
20 Amps.	13.25	24.00	35.00	90.00
24 Amps.	16.00	31.00	39.50	96.00
30 Amps.	21.50	38.00		
36 Amps.	25.50	45.00		

- **New, Selenium Rectifier Transformers**

PRI: 115 V., 60 cycles in. } 4 Amps..... $ 8.75
SEC: 9, 13, 18, 24, and 36 volts } 12 Amps..... 16.75
24 Amps..... 35.75

Made to our specs. for continuous, heavy-duty use.

- 115V. PRI—36V. 50 amp second XFMR. $39.95
- 115V. PRI—6V. @ 190 Amp. SEC..... $59.95
- 115/230 V. 60 cy. PRI. SEC.: 1.5, 30.5, 33.5, and 36.5V @ 4 AMPS. Herm. Sealed....@ $6.50

- **New Selenium Rectifier Chokes**

4 Amps.—.07 hy.—.6 ohm..... $7.95
12 Amps.—.01 hy.—.1 ohm..... $14.95
24 Amps.—.004 hy.—.025 ohm..... $29.95

We manufacture standard as well as special types of selenium rectifiers, rect. supplies and XFMRS. Low prices . . . Write. You will like our quick service, low prices, and good workmanship.

32 KV. VACUUM CAPACITORS. EIMAC BOXED
6MMF.....$6.50 — 12 MMF.....$10.95
50 MMF.....$13.50

- **Stiley-Type SMC100— Crystal Standards. New—100 KC. and 1.000 KC Bar..... $8.50**
- **ART-1—DeLuxe 75 Meter AM Mobile XMTR—New—Complete..... Only $19.95**
- **AR-11—Complete Station for 20, 40, 80. Superhet Rcvr—40 Watts CW w/built in AC Pwr Supply. New—in compact suitcase (orig. cost over $500) Special..... Only $99.50**
- **Wooten Meters. 0-100 micro amps. 2½" Diam. (Blank Scale) New Boxed. VERY Special.. $5.95**

Terms: FOB-NYC—25% Deposit with order—or send full remittance to save COD charges—Rated Firms (D.&B.) Net 10 days — All merchandise guaranteed.

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ATR-13 TRANSCEIVER

Dynamotor powered, either 14 or 28 V. Shock mounted, remotely controlled transceiver. Tunable receiver, range 108-160 M.C., 4-channel crystal controlled VHF transmitter, built-in provisions for omni. Weight, complete with plugs, less cable, 19 lbs. Less crystal.
new **$245.00**

PORTABLE RADAR

Model SQ. 12 cm. Used on small ships. Has PPI indicator. Maximum range 20 miles. 1 Kw. output. Operates from 110 VAC, 60 cps. Price On Request.

NEW HEADSETS & HANDSETS

HS-23	HS-38	T8-10-G	T8-13-C	AS-83
HS-33	HS-18	T-36	HS-38	

RADAR

APS-4	Complete Radar	RC-1841FF
APS-6 Complete	Mark 16	RC-214
APT-1	MD4/APS2	RC-224
APT-2	MD5/APS3	RC-266
APT-3	MD22/UPN2	RT34/APS13
APT-4	MD38/APQ13	T-85/APT-5

TEST EQUIPMENT Complete Line!

DuMont 224-A Oscilloscope		TS-118/AP
1-77 Hickok Tube Checker		TS126
1-208 FM Signal Generator		TS127/U
RPC Model 644 Multimeter		TS131
Ferris Microvolter Mod. 18-C		TS158
Hewlett Packard 200-C		TS170/ARN
I-198	TS19/APQ	TS-173/UR
BC-638	TS-23/APN	TS175/UP
BC-1255	TS24A/ARR-2	TS182/UP
IE-30	TS27/TSM	TS184A/AP
I-95?	TS-33	TS204/AP
I-96(	TS34/AP	TS251
I-122	TS-35/AP	TS311A/UP
I-130A	TS36/AP	TS323/UP
I-139	TS-45A/APM-3	I-146
I-145	TS61/AP	TS-268/U
I-212	TS62/AP	Boonton Mod.
I-223	TS89	78B Sig. Gen.
TS-3A/AP	TS92	Boonton Type
TS10A/APN	TS100/AP	102F Sig. Gen.
TS12/AP	TS-103	
TS16/APN	TS111/CP	

TS-159/TPX

COMBINATION SIGNAL GENERATOR AND FREQUENCY METER. Freq. range: 150-200 MC., crystal calibrated. Has separate 30 MC signal output, crystal cal; detector, AF amplifier. Power measurements by built-in VTVM circuit. 0-1 MA. meter as 2-range voltmeter. Built-in 400 cps. voltage regulated power supply. New.....$69.95

POWER SUPPLY

110 V. 60 cps., 4 tubes voltage regulated. Power output 200 VDC @ 70 MA. and 6.3 VAC @ 7 amps. Used to supply necessary power for radar transmitter G-23200. New.....$39.95

RADAR TRANSMITTER

Model G-23200. 15 tubes. Has 4 independent oscillators, each adjustable in frequency between 509-521MC, by means of knobs on front panel. Has 4 independent variable pulse shaping modulators, complete with tubes. Requires above separate POWER SUPPLY. New $89.95

AN/ART-13 PARTS

Part #	Item
564916	Barometric Switch
565027	4-Pile Ceramic, Variable Cap.
K7890443	6-Pile Ceramic, Variable Cap.
564605	4 Centralab-Type 843-003 Cap Assembly

RA-38 RECTIFIER

High voltage power supply. Used with ground radar set. New. Price on request.

FLUX METER

For measuring flux density between magnet poles. Has two meters in series with a potentiometer and battery for power supply. Range: 500-4000 Gauss in 3 scales. Requires 1 battery which mounts in case. NEW $37.50

RECEIVERS—TRANSMITTERS

APR-4	MP-10G	ETA/7B
APR-5	PE-125AX	SCR-522
ARC-1	R-9/APN-4	TA23-24
ARC-3	340-580 MC. New	733-D
R-4/ARR-2	complete	
ID-6/APN-4	R89	

RA-52 RECTIFIER

Transtat controlled to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 VDC @ 50 W. Metered high voltage (0-15 KV) and current (0-20 MA). New.....$74.50

MISCELLANEOUS

MINE DETECTOR: SCR-625 for prospecting, mining, etc. NEW $59.50
LP-21 LOOPS: Mod. LM, AM, A. Excel. cond.

- *NOTE:* WE HAVE ONE OF THE LARGEST,
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(See Arrow Sales Inc. ad Page 471)

POWER RHEOSTATS

Ω	W	Ea.	Ω	W	Ea.	Ω	W	Ea.
.25	25	1.95	75	25	1.95	300	50	2.44
.5	50	2.81	75	75	3.90	585	150	6.59
.5	150	5.93	80	50	2.53	750	25	2.23
1	50	2.81	500	12	44.75	750	150	5.44
2	50	2.81	100	25	1.95	1000	25	2.53
2	100	4.65	100	50	2.53	1000	50	2.66
2	300	8.42	100	100	4.39	1200	225	7.38
3	100	4.67	125	25	2.23	1200	300	8.49
3	225	6.58	150	50	2.53	1250	50	2.66
4	225	6.60	175	25	2.23	1250	150	6.18
5	25	1.97	185	25	2.23	1500	25	2.53
5	50	2.53	200	25	2.23	1500	50	2.66
5	100	4.65	200	100	4.40	1600	50	2.66
6	25	2.23	200	150	5.84	1800	150	6.18
6	50	2.53	225	50	2.53	2000	25	2.53
6	75	3.90	250	25	2.23	2000	50	2.66
7	25	1.98	250	50	2.53	2250	150	6.24
7.5	75	3.95	300	50	2.53	2500	50	2.66
8	50	2.53	300	75	3.90	2500	100	4.65
10	25	2.23	300	100	4.40	2500	150	6.24
10	50	2.53	300	150	5.84	3000	25	2.66
10	100	4.37	350	25	2.25	3000	100	4.95
12	25	2.23	350	100	4.40	5000	25	2.66
12	50	2.53	370	25	2.23	5000	50	2.90
15	25	1.98	375	150	6.59	7500	50	2.90
15	75	3.90	400	25	2.23	7500	100	5.32
15	100	4.38	400	75	3.90	10000	50	2.99
20	50	2.53	500	25	2.23	10000	100	5.32
22	50	2.53	500	50	2.53	10000	100	5.51
25	25	2.23	500	75	3.95	15000	25	3.25
50	25	1.98	500	100	4.40	20000	150	8.75
50	50	2.53	500	150	5.15			

Specify Type Shaft Required "S" or "Knob"
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- **MANY OTHER ITEMS**

HIGH POWER TRANS. MICA

G-1 Type		G-2 Type		G-3 Type		G-4 Type	
.0001	6kv	.0001	10kv	.0001	20kv	.00025	30kv
.00015	5kv	.00015	10kv	.00015	20kv	.0006	35kv
.0002	6kv	.0002	10kv	.0004	20kv	.0025	25kv
.0008	6kv	.00025	12kv	.00045	15kv	.003	20kv
.01	4kv	.0003	10kv	.00047	20kv	.0039	20kv
.032	2kv	.000375	10kv	.0005	20kv	.0075	15kv
.04	1kv	.0004	5kv	.00095	5kv	.01	12kv
.051	1.5kv	.0005	10kv	.001	20kv	.02	8kv
.08	1.5kv	.00057	10kv	.0011	20kv	.056	8kv
.09	1.5kv	.00065	10kv	.00124	15kv		
		.001	10kv	.01	5kv		
				.015	5kv		
				.25	1.6kv		

C-D Type #58

.000155	30kv	.001	30kv
.0004	30kv	.03356	2.5kv
.000533	30kv	.007/15kv	70A/300kc

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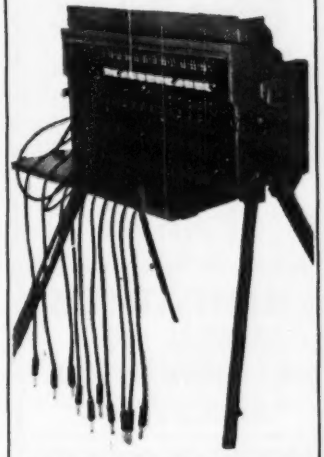
Switchboard BD-72 and BD-71



These Switchboards are portable, monocord, magneto-telephone switchboards for use primarily in field wire systems.

The capacity of the Switchboard BD-72 is 12 lines and of the BD-71 is 6 lines. Each switchboard contains all the equipment necessary for terminating and switching field telephone circuits, including a line terminal strip to which incoming lines may be connected directly.

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Line Cord—Black Rubber 6 ft., Angle Molded Plug ..... Ea.: 39¢ — 3 for $1.00

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PL-112 Plug for LP-21 Loop..... $1.25
PL-P-103 Plug for BC-348..... 1.50
MC-211 Hightangle Adapter for Comm. Sets.... .50
M-359 Rightangle Coaxial Connector..... .25

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	NEW:	USED:
C-87/ART-13—f/ART-13 Trans ...	$ 6.95	$4.95
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BC-434 for ADF.....	5.95	3.95
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MC-396 Wood Clamp for Fairlead..... .75
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14 V. DC	375 V. 150 MA.	DM-375	9.95
14 V. DC	330 V. 135 MA.	DM-330	7.95
14 V. DC	500 V. 500 MA.	PE-59	14.95
12 or 24 V. DC	275 V. 110 MA.	USA/0516	2.95
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1N21A	1.50	2C46	27.50	3C22	120.00	6SU7GTY	2.25	121A	2.95	721A	2.25	957	.45	1625	.45	9001	.90
1N21B	3.25	2C51	6.75	3C31/C18	2.50	9GP7	12.50	F127A	17.00	723AB	17.50	958A	.59	1641	1.95	9002	.89
1N23A	2.25	2J31	22.00	3C45	15.00	10Y-G.E.	.49	211 G.E.	1.25	726A	8.25	1005	.59	1644	.85	9003	1.25
1N23B	3.50	2J32	37.50	3E31	12.50	15E	2.35	507AX	1.45	814	2.50	1006	2.95	2050/1605	1.40	9004	.65
1N26	7.75	2J48	37.50	4C27	22.00	T21	1.50	532A	3.75	815	1.50	1007	.85	2051	1.00	9006	.49
1N34	.65	2K25	22.50	6AK5	.85	RK72	1.45	705A	1.75	872A	3.25	HY1249	2.25	5670	6.50				
1B23	2.75	2X2	.49	6AL5	.39	VR105	1.25	706CY	45.00	911A	3.95	1613	1.15	5782	5.50				
						VU111	1.20	715A	5.95	954	.39	1616	.65	7193	.45				

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APA-23	I-186	Tester	TS-170
BC-1016	I-155		TS-226
BC-1236	LM	TS-3	TS-323
Microvolter	LS-1	TS-10	TS-419
BC-221-T1	GR-583A	TS-11	TN-1,
BC-906	output	TS-12	2, 3
BC-221	meter	TS-13	TN-16
BC-438	Ferris 20A-1	TS-16	TN-17
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6AQ5	.41	35C5	.41
6AT6	.32	35L6GT	.45
6AU6	.37	35W4	.26
6AV6	.37	35Z5GT	.31
6AX4GT	.54	50B5	.41
6BA6	.38	50C5	.41
6BC5	.46	50L6GT	.43
6BD6	.41	117Z3	.34
6BE6	.40	803	2.95
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6BQ6GT	.77	3DP1	9.95
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OC3/VR105	.59	2E30	1.98	3DP1	3.95	6AN5	3.65	217C	4.95	781A	4.50	838	2.25	5528/CSL	5.95
OD3/VR150	.90	2J21A	7.95	3E29	13.95	6AS6	2.75	221A	1.95	782A	2.75	845	4.25	5611	Write
1B22	2.25	2J22	6.95	3FP7	1.95	6BN8	Write	RK233A	3.50	783A	4.95	851	39.95	5635	8.95
1B23	2.95	2J26	14.95	3GP1	3.95	6C21	19.50	250R	8.95	785A	1.50	852	19.95	5638	8.95
1B24	9.50	2J27	14.95	3HP7	3.95	6F4	5.50	258TH	28.00	786A/BY/FY		860	3.75	5645	8.95
1B26	2.25	2J31	27.50	4-125A	25.00	6J4	6.95	274B	3.25	GY	25.00	861	19.95	5646	8.95
1B27	2.25	2J32	27.50	4B26	6.95	6N4	4.50	275A	Write	787A	1.95	864	.25	5654	3.95
1B32	3.10	2J33	27.50	4C27/CV92	17.50	6SN7WGT	1.98	304TH	8.95	787B	14.95	865B	53.00	5656	19.95
1B37	14.95	2J34	27.50	4C28	25.00	7C23	59.50	304TL	8.95	788A	3.95	872A	2.75	5672	2.00
1B38	24.50	2J36	110.00	4C35	24.50	12AY7	4.50	307A/RK75	4.25	714AY	4.50	874	.49	5676	3.25
1B40	47.50	2J37	12.70	4E27	14.50	12BH7	16.95	327A	4.50	715A	6.25	876	.59	5694	2.50
1B47	12.50	2J40	27.50	4J21	129.50	12GP7	25.00	331A	19.95	715B	8.95	881	1.50	5702	6.50
1N21B	2.75	2J48	27.50	4J22	129.50					715C	22.75	884	1.60	5703	1.98
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1N23	1.25	2J61	39.50	4J27	129.50					720AY	Write	927	1.25	5726	2.95
1N23A	2.25	2J62	39.50	4J28	129.50					720BY	Write	930	1.25	5744/619CX	5.95
1N23B	3.55	2K22	Write	4J29	249.50					721A	1.95	933A	6.50	5745	5.95
1N26	7.50	2K23	29.50	4J30	249.50					722A	1.95	953B	Write	5783	6.00
1N28	Write	2K28	32.00	4J31	99.50					723A/B	16.95	953D	Write	5784	5.50
1N34	.65	2K29	23.95	4J32	129.50					724B	2.75	953E	15.00	5787	6.00
1N38	1.50	2K39	99.50	4J35	99.50					725A	6.95	954	.33	5814	4.50
1N40	8.50	2K45	90.00	4J41	99.50					726C	69.50	955	.49	5823	3.95
1N54	.85	2K48	Write	4J52	Write					738A	25.00	956	.49	5844	3.95
1N55	2.75	2K54	Write	4X150A	15.00					802	1.95	957	.49	5915	1.00
1N56	.89	2K55	Write	5BP4	4.50					803	1.75	958	.69	6005	4.25
1N58A	1.25	2X2	.59	5CP1	4.50					805	1.75	959	2.95	6053	3.95
1N60	.60	2X2A	1.59	5C22	35.00					807	1.59	977CX	Write	6085	4.95
1N63	2.39	3A4	.65	5D21	19.95					808	2.95	979P	Write	6812	1.95
1Z2	Write	3A5	.85	5FP7	1.95					809	2.95	986D	Write	6813	4.95
2AP1	8.95	3AP1	8.95	5FP14	16.50					810	16.95	991	.39	6914A	Write
2C21/1642	.65	3B2K	4.95	5GP1	4.50					811	2.96	1005	.69	8020	1.25
2C22/7193	.29	3B24W	7.50	5JP1	17.50					812	2.75	1006	2.75	8025	4.95
2C26A	.39	3B28	3.50	5JP2	17.50					814	2.95	1007	.69	9001	1.25
2C40	8.50	3B28	6.50	5JP5	17.50					815	2.50	1616	.90	9002	.90
2C43	24.50	3BP1	4.95	5J21	Write					829	8.95	1624	1.45	9003	1.50
2C44	1.19	3C22	80.00	5J26	149.50					829B	11.95	1625	.39	9004	.69
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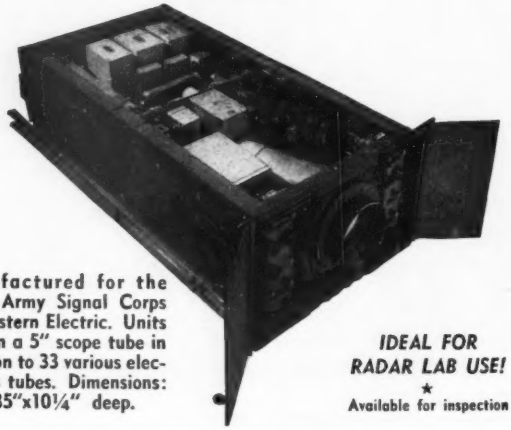

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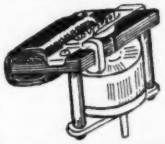

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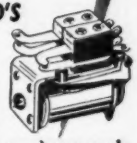

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6x14x3"	1.05	.45	10x17x2"	1.33	.73
7x7x2"	.75	.33	10x17x3"	1.38	.73
7x9x2"	.90	.35	10x17x4"	1.70	.73
7x11x2"	.93	.43	11x17x2"	1.73	.75
7x13x2"	.99	.48	11x17x3"	2.05	.75
7x15x3"	1.20	.53	12x17x2"	1.43	.80
8x17x5"	1.68	.43	12x17x3"	1.70	.80
7x17x3"	1.30	.55	12x17x4"	1.88	.80
8x17x2"	1.20	.55	13x17x2"	2.05	.88
8x17x3"	1.30	.55	13x17x3"	2.38	.88
10x12x3"	1.25	.55	13x17x4"	2.70	.88

OIL CONDENSERS
Bathtubs, Uprights, Channels, etc. Lowest Prices Centralab Hi-Volt Caps: TV1-5051, 10,000 VDCW—.39c TV1-502 and TV2-502, 20,000 VDCW—75c. TV1-503, 30,000 VDCW—$1.08

BRAND NEW TUBES
RCA—GE—SYLV. ONLY—LATE STOCK

1R5	$.79	6AT6	$.62	6SJ7	$.69
1B3	.95	6AU6	.72	6SN7	.85
1x2A	.95	6AV6	.62	6W6GT	.69
5U4G	.59	6BC5	.7	12AU7	.85
5V4G	.98	6BG6	1.95	12BA6	.69
5Y3GT	.45	6BQ6	1.29	12BE6	.69
6AC7	1.19	6CB6	.69	12SA7	.75
6AG5	.86	6J5	.59	35W4	.59
6AK5	1.69	6J6	.95	50B5	.75
6AL5	.65	6K6	.59	50L6	.69
6AQ5	.78	6L6G	1.18	16AP4A	25.00

SPECIALS: Amphenol 8 Prong Octal Sockets =CP8 with retainer rings—7c, #3-13 Plug Caps—7c. ICA Type Brass N.P. Binding Post, 8/32 Male Threaded Shank, No Markings—6c. Plexiglas-New Masked, 3/64" Clear $1.30 Sq. Ft. ¼" $1.95 Sq. Ft. Machining, Drilling, Forming, etc. Done as Special Service for Schools, Labs, Experimenters.

PHONE CYPRESS 8-6940
WHOLESALE ELECTRONICS
224 E. 204 St. N. Y. C. 68, N. Y.

HIGH FREQUENCY EQUIPMENT

GE-Leland MG set. 5 HP, 220V, 3 ph. 60 cy. motor & 24/32V DC, 78 amp. generator, on common shaft, direct-driving Leland 3KVA, self-excited, 3450 RPM, 400-cy., 3-ph., 120/208V, 4-wire alternator. Alternator has excellent wave form. 400-cy. alternator is electrically independent of low voltage generator. $995.00
Voltage regulator for above to regulate plus or minus 2 volts. $125.00
Newton Bros. MG set. 2½KW, 1-ph., 400-cy., 2400 RPM alternator, belt-driven by Fairbanks-Morse, 7½HP, 220V, 3-ph., 60-cy., 3450 RPM motor $500.00
Ballantine MG set. NEW. 1KVA, 1-phase, 400-cy. alternator, 115V, self-excited; belt-driven by NEW 2HP motor, 220V, 3-ph., 60-cy. With voltage regulator & variable speed sheave. $300.00
belt-driven by NEW 2HP Motor, 115/230V, 1-phase, 60 cy. With voltage regulator & variable speed sheave $400.00
Onan Electric Plant. BRAND NEW. Gasoline-driven AC output 120V, 10 amps, 1200W, 800 cy. DC output 28V, 18 amps, 500W $250.00
Batteries for self-starting Onan Plant $45.00

EDWARD WOLF COMPANY
P. O. Box 82 Mattapan 26, Mass.
BLuehills 8-1254

WILL SELL BRAND-NEW

1 Ferris Model 22-D Signal Generator	$1195.00
1 Model 80 Signal Generator	$1055.00
1 80-ZH3 Pad	$ 29.25
1 80-ZH4 Cable	$ 29.25

No waiting for defense orders on this equipment. Address inquiries:

SERVICIOS AERONAUTICOS de MEXICO, S.A.
AEROPUERTO CENTRAL
Mexico, D. F., Mexico
Attention: Sales Manager

this Searchlight Section of **ELECTRONICS**

is an index of reliable sources for Surplus or Used Equipment now available. Consult the **Searchlight Section** in following issues for later offerings.

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And, when you have special items to dispose of, use the Searchlight Section of Electronics to help you locate buyers . . . Send a list of your equipment and we will gladly give full information as to space and rates.

Classified Advertising Division

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330 West 42nd St. • New York 18, N. Y.

Somebody—Somewhere,
needs your idle equipment! Reach that buyer quickly and economically thru the
"SEARCHLIGHT SECTION"
The meeting place of Used Equipment Buyers and Sellers

OIL CONDENSERS

2 MFD. 5000 VDC with brackets $11.95
6 MFD. 600 VDC CP 70 BIFF 605K with Brackets, $2.75 each; by 100 lot each $1.37
1 MFD. 2500 VDC Type TJ $2.75
4 MFD. 1500 ..... $2.98
10 MFD. 2500 V. $7.98
1 MFD. 6000 VDC Interteen Type FP $12.75
BATHTUB CONDENSERS CP53B1FF564K .5MFD—600V ..... $.61
Round 1 MFD. 1000 VDC screw Type 1 Lug 2¾" High ..... 59c ea.
.05 MFD-600 V ..... 35c ea.

RHEOSTAT

TYPE J150 ohm 50 Watt #5381 ..... $1.89 each
TYPE K 100 Watt 25 Ohm $2.96
TYPE H 25 Watt 15 Ohm $1.67

PACKET SWITCHES made by A&H&H Type 80089 25 amp. size 2PDT and 3DP ..... $7.95 ea.
SELECTOR SWITCHES CENTRALAB Non shorting Type 1401 1 Pole 2-6 position ..... 49c ea.

EQUIPMENT

1—SCR 522 (BC 624A-BC 625A) New in original crate with following accessories: Antenna AN 188, 3 control boxes BC 1312-13-14, 1 cord 809-A, 1 cord Cd 133 RG 8U, coax.cable w/ all plugs $125.00
2—(same as above without accessories—slightly scratched cabinet, $65.00 each.
2—New (in original boxes) type CH 172-B Power Supply for above equipment, contains 500 ft. cable, 7 conductors and 1 rectifier RA 62 B ..... $100.00 each.
1—Oscilloscope TS—198/CPM—4 for observation of elec'l. wave shapes and radar A—scope $125.00

TUBES

721A	$3.00	9001	$1.35
815	2.50	9002	1.35
829B	14.50	9003	1.50
830B	3.00	9006	0.40
832	6.95	EL1C	2.75
832A	9.00	GL6G	1.35
1B24SYL	13.95	2J49	105.00
3B24	5.50	2J50	65.00
4J37	125.00	2J38	15.00

Weston WATTMETER Model 641 0-4 KW 250 V, 20 amps. $32.50
Voltmeter Westinghouse Type NX35 0-300 V DC 3½" rd. FS-1MA $12.35
0-300V AC Type NA-11 FS-1MA $7.85
0-150VAC Sterlington 2" $4.75
Meter 0-15 MA-DC Westinghouse RX-37 4" square $11.85
COUNTER Veeder Root Ratchet 5 Number Type 1144 ..... $1.19

UG CONNECTORS

UG 352U	$6.00 EACH
UG 9/U	.95 EACH
UG 483	2.60 EACH
MX 564-U, Chassis type	5.75 EACH
83-22 R	.75 EACH
Selenium Rectifier, C. E. 4½ V input, 24 V output, D. C. 4 amps	$12.95
Selenium Rectifier, Rectox 62 V input, 24 V output, D. C. 4.88 amps	$12.85

ALL the material in STOCK

HAYDON SYNCHRONOUS MOTOR

110 V.A.C.
½ R.P.M.
3.6 Watts
$2.75 each

Haydon, 2.2 watt 1-120 RPM $2.75
complete with coin arrangement for 25¢ pc. $2.95
minimum order 5 pcs. on synchronous motor.

Haydon, 3-6 watt, 1.5 RPM #5901-4, adjustable reset timer $7.50

MICA TRANSMITTING CAPACITORS Type G: .0001 Mfd 25KV ..... $35.00 ea.
Type G2-50, .0001 mfd, .0002 mfd, .0005 mfd, 10KV $10.00

Type H, .01 mfd, 2500 V test, #CM50A103M $66.00/hundred
Type 1445.01, 1200 V test, #CM45B103K $30.00/hundred

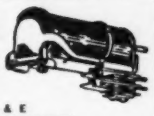
ATTENUATOR DAVEN TYPE T-994-2 7500/3900-2DBStep $4.25
Type TA-1000-2 7500/3900 Ohm ..... $3.25 ea.

RELAYS

SIGMA 12 Volts DC S.P.D.T. size 2¼" x 1¾" ..... $.77 each
G E TYPE CR2791—B109P36 S.P.D.T. 10,000 Ohm Coil $1.05
G E TYPE CR2791—B109U39 150 Ohm Coil $1.15

LEONARD GREENE
381 Tremont St.—HA 6-4794 **BOSTON, MASS.**

TELEPHONE RELAYS



Large Stock of
CLARE, TYPES C, D & E
COOKE, AUTOMATIC—ELECTRIC
ALL TYPES of COILS and PILE-UPS
Send Us Your Specs. for Our Quote

Clare Type G Half Size Sensitive Telephone Relays

	Coil	Contacts	Will Close At	Price
1)	6500 ohms	2A	3 MA	$2.50 ea.
2)	5800 ohms	3A	5 MA	2.50 ea.
3)	5800 ohms	2B-1C	5 MA	2.50 ea.
4)	4850 ohms	1C	4 MA	2.50 ea.
5)	3600 ohms	1C	6 MA	2.00 ea.
6)	4850 ohms	1A	5 MA	2.00 ea.
7)	3300 ohms	(None)	ACTUATOR	1.50 ea.

All above Relays may be used for continuous duty operation on 110V, D.C.

Other Type G Telephone Relays

1)	1300 ohms	1A-1C	24 or 48V.	2.50 ea.
2)	700 ohms	2A-1C	24V.	2.50 ea.

CONTACT SYMBOLS
A-Norm. Open B-Norm. Closed C-S.P.D.T.

G. E. Relays #CR 2791-B109P36 Coil—10,000 ohms Contacts 1A, 1B Operates on 8 MA. ..Price $1.65

Signal Wheelock Relays #K89665 Coil—2,000 ohms Contacts-1A, 1B, 1C Operates at 9 MA. ..Price—$2.75 ea.

Leach Relays Type 1025-8N-BF. Coil—24V. 425 ohms. Contacts—D.P.S.T. Norm. closed. Rated at 10 Amps ..... Price—$1.50 ea.

Five Prong CR-2791 G.E. Plug In Relays.
1) C-103C25 2200 ohms SPDT 4.5 MA...$4.00 ea.
2) C-104B28 700 ohms SPDT 6 MA.....$3.00 ea.

Slow Release (For SCR-522-A) Telephone Relays. Part No. A18258. ..... Price—$2.00 ea.

Patch Cords—2½ Ft. long with a Phone Plug (Like PL-55) on each end. ..... Price—95c

Chase

Electronic Supply Co.
222 Fulton St.
New York 7, N. Y.
Digby 4-3088
HOllis 4-5033

"AN" CONNECTORS

AN-3100 AN-3101 AN-3102 AN-3106 AN-3108

SOCKET INSERT (Female)

Any of the shells pictured here may be used with any of the inserts listed. For example: If a right angle cable connector is desired with a 20-29 pin insert

Shell 3108 Size 20 Socket Insert 29P

PIN INSERT (Male)

16-1	16S-1	18-8	20-4	20-32	22-23	24-15	28-11	32-19	40-8
16S-2	16S-3	18-10	20-5	20-35A	22-24	24-16	28-14	32-20	40-9
16S-2	16S-4	18-13	20-6	22-1	22-25	24-17	28-16	32-101	40-7
16S-456	16S-5	18-12	20-7	22-2	22-26	24-18	28-16	32-103	40-9
16S-1	16S-6	18-13	20-8	22-3	22-27	24-19	28-17	36-1	40-10
16S-4	16S-8	18-14	20-9	22-4	22-28	24-20	28-18	36-2	40-11
125-1	16S-14	18-15	20-11	22-5	22-29	24-21	28-19	36-3	40-11
125-2	16S-15	18-16	20-12	22-6	22-30	24-24	28-20	36-4	40-743
125-3	16S-16	18-17	20-13	22-7	22-31	24-25	28-21	36-5	44-1
125-4	16S-17	18-18	20-14	22-8	22-34	24-26	28-22	36-6	44-2
125-6	16-2	18-20	20-15	22-9	22-36	24-28	32-1	36-7	44-3
145-1	16-7	18-22	20-16	22-10	22-37	24-76B	32-2	36-9	44-4
145-3	16-9	18-23	20-17	22-11	24-1	24-653A	32-3	36-10	44-6
145-4	16-10	18-24	20-18	22-12	24-2	28-1	32-4	36-13	44-6
145-5	16-11	18-25	20-19	22-13	24-3	28-2	32-5	36-14	44-7
145-6	16-12	18-26	20-20	22-14	24-4	28-3	32-6	36-15	48-2
145-7	16-13	18-27	20-21	22-15	24-6	28-4	32-7	36-16	48-3
145-9	16-14	18-28	20-22	22-16	24-6	28-5	32-8	36-17	48-4
145-10	18-1	18-29	20-23	22-17	24-7	28-6	32-9	36-18	48-5
145-11	18-3	18-30	20-26	22-18	24-8	28-7	32-10	36-21	
145-12	18-4	18-31	20-26	22-19	24-10	28-9	32-12	40-1	
145-13	18-5	20-1	20-27	22-20	24-11	28-10	32-13	40-2	
145-14	18-7	20-2	20-28	22-21	24-12	28-13	32-16	40-3	
14-3	18-9	20-3	20-29	22-22	24-14	28-12	32-18	40-4	

Available for immediate delivery from stock.
Write, wire, phone your requirements. Complete stock of UG Connectors. Send for our bulletins and listings of all components.

ACORN ELECTRONICS CORP.

76-E Vesey St. *WOrth 4-3270* **New York 7, N. Y.**

Standard Brands **Electronics, INCORPORATED** *All Items Fully Guaranteed*

ATTENTION — First Listing of a New and Exciting Condenser Inventory!

CP 70 STYLE CONDENSERS

MFD	Voltage DC	Type
.0091	15 KVDC	14F113
.075	16 KVDC	572
.01	600 VDC	OM6001
.02	600 VDC	P13356
.05	600 V	OM6005
.05	1000 V	23F203G2
.05	3000 V	23F636
.05-.05	2000 V	P720555-69
.05-.05-.05	500 V	B34584
.1	600 V	28F28
.1	1750 V	CSF 48596-AP
.1	2000 V	23F378
.1	3000 V	T30001G
.1	3500 V	XLMW351
.1	7500 V	25F475
.1	10 KV	14F267
.1	12 KV	26F628-10
.1	13 KV	2FF313B
.1	15 KV	26F359
.1-.1	600 V	SPG6210B
.1-.1	7 KV	25F774
.1-.1	7500 V	7520
.1-.1-.1	600 V	CP70E1AF405K
.25	600 V	CP65B
.25	1000 V	23F242
.25	3000 V	3009
.25	6000 V	25F659
.25	7500 V	25F431
.25	10 KV	D9181
.25	20 KV	TK 20002
.25	25 KV	8118
.25-.25-.25	600 V	CP69B5EF-254
.49	10 KV	408936
.5	600 V	CP70B1EF504V
.5	1000 V	TJU10005
.5	2000 V	26F698
.5	2500 V	PO12509
.5	3000 V	CP70E1E504N
.5	4000 V	23F409
.5	5000 V	TJH50005
.5	10 KV	408936
.5	25 KV	14F103
.5-.5	400 V	RAL300
.5-.5	600 V	7708BR
.5-.5	1000 V	9107
.5-.5	2000 V	26F864
.5-.5	3000 V	25F525
.5-.5	9000 V	PC2151
.5-.5-.5	500 V	B34584
.875-.875	400 VDC	23F279
1	400 VDC	CP69B2BE1105MK
1	500 VDC	9CE6A4
1	600 V	CP70B1EH105V
1	1000 V	TJ10010-2
1	1200 V	7870691
1	1500 V	CP70B1EH105V
1	1750 V	CSF48596
1	2000 V	TRS2001
1	3000 V	CP70E1FL105V
1	5000 V	23F49-G2
1	6000 V	TJ60010A
1	10 KV	14F276
1	15 KV	14F63
1	25 KV	14F59
1.5	1500 V	K7106149A
2	200 V	TRS202
2	600 V	CP70B1-
2	1000 V	CP70B1EFG205K
2	1500 V	TRS1502
2	2000 V	23F161
2	2500 V	2509R01
2	3000 V	TQ30020
2	4000 V	23F47-G2
2	5000 V	23F188
4	400 V	25F66G2
4	600 V	CP70E1EF405K
4	1000 V	CP70D1DG6405K
4	1500 V	XLMW15-4
4	2000 V	23F119
4	2500 V	TRS2504
4	3000 V	TJ 30040-7
4	4000 V	25F664-G2
4	5000 V	TJ50040
5	600 V	KLMRW6-5
5	1000 V	XLMW10-5
5	10 KV	TK10050G
6	600 V	TRS606
6	1000 V	TJ10060
6	1500 V	CAY48731-10
6	2000 V	CAY48730
8	200 V	TRS208
8	600 V	TRS608
8	1500 V	TJ15080
8	3 KV	P15988
10	600 VDC	25F339
10	1000 VDC	TJH10100
10	2500 VDC	23F397
12	1000 VDC	0115
12	4000 VDC	35-83P1
15	1000 VDC	TJ10150
15	1500 VDC	TJ15150
25	2800 VDC	Photo flash
25	3000 VDC	Photo flash
.05	300 VAC	PC1344-3
.14	115 VAC	26F988
.6	90 VAC	Type 1C Model 2
1	150 VAC	25F757
1	220 VAC	21F319
1	330 VAC	67X1
2	330 VAC	26F406
3	330 VAC	26F536
3-3-3	90 VAC	Type 9C Model 2
3.5	220 VAC	21F319
3.75	330 VAC	KG3037
4	440 VAC	67X23
5	440 VAC	21F120-G2
6	330 VAC	KGM3060
6	440 VAC	Vit. Q
6	660 VAC	67X38
8	660 VAC	21F5063
8	1500 VAC	22F57
10	220 VAC	ALMJW22-10
10	330 VAC	PRF3310
10	660 VAC	25F698
10-10-10	90 VAC	26F57163
12	220 VAC	MC787
12	330 VAC	21F130
15	330 VAC	25F801-G2
15	660 VAC	26F495
16	660 VAC	PC1330
500	100 VAC	KLHRAW1-50
500	330 VAC	KGH3500-3

VACUUM CONDENSERS

VC-6 VC-50

STANDARD BATHTUB CONDENSERS

MFD	Voltage	Terminal
.01	600 VDC	Side
.05	600 VDC	Side
.05-.05	1000 VDC	Side
.05-.05-.05	600 VDC	Side
.08	1500 VDC	Top
.1	600 VDC	Side, Top, Bottom
.1	1000 VDC	Side
.1-.1	400 VDC	Side
.1-.1	600 VDC	Side
.1-.1-.1	400 VDC	Side
.1-.1-.1	600 VDC	Side
.2	600 VDC	Side
.2	1000 VDC	Side
.25	400 VDC	Side
.25	600 VDC	Side, Top, Bottom
.25-.25	400 VDC	Side
.25-.25	600 VDC	Side, Top, Bottom
.25-.25-.25	600 VDC	Side
.3	600 VDC	Top
.5	300 VDC	Top
.5	400 VDC	Side
.5	600 VDC	Side, Bottom
.67	120 VAC	Side
.75	600 VDC	Bottom
1	100 VDC	Side
1	200 VDC	Side
1	300 VDC	Side
1	400 VDC	Bottom
1	600 VDC	Side
1	1000 VDC	Side
1-1	400 VDC	Side
1-1	600 VDC	Bottom
2	25 VDC	Side
2	400 VDC	Side
2	600 VDC	Side
4	50 VDC	Side
4	100 VDC	Side
4	450 VDC	Side
10	150 VDC	Side
20	150 VDC	Side
30	150 VDC	Bottom
25	25 VDC	Side
25	50 VDC	Side, Top
40	25 VDC	Side
50	25 VDC	Side
50	50 VDC	Side

PULSE TRANSFORMERS

WESTINGHOUSE			
1P1	132 BW2	145 EW	
1P8	132 DW	145 EWP	
1P26	133 AW	166AW	
1P29	134 BW	176 AW	
132 AW	134 BW2	301445-1	
UTAH			
X124 T-2	X154 T-1	9318	
X124 T-3	9280	9287-D	
X143 T-3	9340	9350	
X146 T-1			
GENERAL ELECTRIC			
68G813	80G13	K9435D	K9478
68G894	80G58	K9449	K9798
68G979	80G59	K9460	K9746-A2
RAYTHEON			
UX 7361-A	UX 7307	UX 7350	

OUR PRICES ARE COMPETITIVE WITH THE LOWEST EXISTING MARKET

• TREMENDOUS STOCK OF TUBES, TRANSFORMERS, AND CONDENSERS •

(For Partial Tube Listing See Our Ad in September Electronics, pg. 454)

Write - Phone - Telegraph

Electronics, INCORPORATED

92 Broad Street, Babson Park, Mass.
Wellesley 5-5210-1

AUCTION SALE

Radio Receiving Tubes

A. J. WILNER AUCTIONEER, WILL SELL ON WEDNESDAY, NOVEMBER 12, 1952 at 11 A.M. on PREMISES 472 BROAD ST., NEWARK, N. J., 2nd FLOOR. ENTIRE STOCK OF RADIO RECEIVING TUBES, SPECIAL PURPOSE TUBES, EQUIPMENT, OFFICE FURNITURE, ETC. REMOVED FOR CONVENIENCE OF SALE FROM STANDARD ARCTURUS CORPORATION

Approximately 500,000 Tubes
Most Tubes are Cartoned—75% are JANS
All Brands—RCA, GE,
Sylvania, Arcturus, Tungsol, Hytron, Etc.

Type	Quantity	Type	Quantity
OA2	1878	6SK7GT	2943
OB2	2753	6SN8GT	427
OZ4	1101	6SQ7GT	61
OZ4G	7754	6U4GT	1875
O1A	360	6U7G	1252
1A5GT	1000	6V6GT	1000
1A6	338	6W4GT	2486
1B5	213	6W7G	187
1C6	381	6X4	2982
1D5GP	524	6X5G	324
1C7G	384	7C4	10727
1E7G	327	7E5	3716
1E7GT	148	12A5	190
1F4	517	12A6	27000
1F5G	251	12BA7	6216
1G4GT	244	12AV6	209
1G6GT	900	12C8	7989
1H5GT	1000	12F5GT	1052
1H4G	1812	12H6	3789
1H6G	209	12J5GT	4272
1H6GT	190	12K8	9238
1G6G	1300	12Q7GT	1039
1J6GT	301	12SR7	386
1L4	12608	12Z3	332
1L5G	351	14A4	291
1LA4	124	18	339
1LC5	249	19	759
1N5GT	1000	19BG6G	4672
1U4	791	22	373
2E5	560	27	190
3B7	221	30 Spec.	65
3D6	1900	31	227
3Q4	4333	32	741
6A6	775	33	998
6AJ6	2730	34	481
6AL5	415	35	1391
6AS5	234	36	1083
6B5	282	37	958
6B8G	1422	38	3866
6B8	4178	39/44	50,000
6BQ6GT	913	46	347
6CB6	2698	49	151
6G8G	241	50	188
6J7G	305	50C5	480
6J8G	181	55	180
6L5G	284	56	316
6P5GT	947	57	67
6R7	200	58	445
6R7G	221	70L7GT	1345
6R7GT	394	71A	649
6S4	256	77	3889
6S7	337	79	113
6SD7GT	7958	81	359
6SN7GT	1000	82	288

Tens of Thousands Other Tubes Not Listed

50,000 Special Purpose Tubes Including:

100-T-H	705A	866A	395A	394A
869B	814	872A	359A	25Z6WGT
2J32	211	FG17	2050W	OD3W
5CP1	3C29	3B25	6AL5W	OR3W
5BP1	719A	3B28	6H6WGT	
2AP1	2050	2D21	5R4WGY	
3GP1	2051	122	8S101	
3C31	884	1Y3	2D21W	
C1B	885	5594	4B32	

200,000 Assorted Cartons and fillers.
Up-To-Date Customer Mailing List with Plates and Machine.

Equipment Used by Standard Arcturus Corporation Tube Testers, Branding Equipment, etc.

INSPECTION—10 A.M. to 4 P.M.—Tuesday, November 11, 1952

WANTED

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330 W. 42 St., New York 36, N. Y.

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GR 650A Impedance Bridge
GR 667 Inductance Bridge
Boonton Q. Meter
Boonton QX Checker
1000 cycle inductance limit bridge

Give Full Details, including Price, Condition, Age.

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- **AN/TRC-1 Equipments.**
- **T14 Transmitters.**
- **R19 Receivers.**
- **TS32 Test Oscillators.**

Any condition or quantity
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WANTED
BD110 Telephone Switchboards, BD100 Telegraph Switchboards, BD90 Power Boards, EE101 V-F Ringers, BE72 Cabinets, FM19 Frames, RA43, REC30, KS-8988, RA87, RA37, RA91 Rectifiers, BD101 Test Boards, SB6 Switchboards, Type CF1A, CF3A, CF2B Carrier Equipments. Any condition and quantity.
W-4212, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED
Federal type
101B Voice-frequency Ringers
Signal Corps type TA-3/FT.
W-4814, Electronics
330 W. 42 St., New York 36, N. Y.

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	6J8G	1.30		25Z5	.65		2E24	4.50		FG27	57.50		CK1006	3.45
	6J8GT	1.00		25Z6GT	.65		2E26	2.75		FG32	59.50		CK1080	1.25
OY4	.45		6K8GT	.65		27	.30		2E30	2.00		FP25	22.50		CK1090	.75
OZ4	.59		6N7	.75		28D7	2.35		2E31	2.35		GL304A	13.25		R1111	3.50
OZ4	.65		6N7GT	.75		30	.30		2E32	1.60		304TH	13.25		R1131C	7.50
1A3	.70		6N8	.85		31	.50		2E36	4.25		304TL	13.95		E1148	.35
1A5GT	.58		6N8GT	.85		32	.47		2E41	3.35		307A	4.50		1201	1.20
1A7GT	.85		6L6G	.75		33A5	.60		2E42	2.75		308A	55.00		1203A	.70
1B1	.65		6L6	2.25		33H5	.67		2E121	2.45		CE309	5.25		1205	.85
1B3GT	.82		6L6G	1.45		33C5	.67		2G22	2.45		310A	7.50		1612	2.25
1B4P	.79		6L6GA	1.45		35L6GT	.67		2H21	125.00		313C	4.35		1618	1.60
1C6	.65		6L7	.85		35W4	.49		2J21A	7.50		316A	.75		1619	2.25
1D5GP	.69		6L7G	.85		35Z3	.69		2J22	10.50		327A	4.75		1619	1.25
1E5G	.71		6N8			35Z4	.60		2J26	17.50		331A	3.25		1621	2.75
1G4GT	.69		6N7	.95		35Z5	.50		2J27	17.50		5340	2.85		1620	6.25
1G6GT	.69		6N7GT	.85		38	.64		2J30	69.50		349A	1.35		1621	2.00
1H5GT	.69		6Q7	.75		37	.59		2J31	27.50		350A	7.75		1622	2.00
1H6G	.75		6Q7GT	.85		39/44	.25		2J32	27.50		368AS	6.95		1623	4.00
1J6GT	.75		6R7G	.85		40	.69		2J34	27.50		371B	1.25		1624	4.00
1L4	.81		6S4	.62		41	.69		2J37A	32.50		393A	8.95		1625	.49
1L6	.95		6S7	.85		42	.65		2K25	27.50		394A	4.75		1626	.49
1LB4	.98		6SA7	.85		43	.65		2R4A	1.95		417A	17.50		1629	.49
1LC6	.91		6SA7GT	.85		45	.59		2X2A	1.95		GL441	4.50		1630	.50
1LH4	.87		6SH7Y	.90		50H5	.75		3A/P1A	14.00		446A	6.95		1632	.85
1LN5	.85		6SC7	.85		50C5	.75		3BP1	5.25		446B	17.50		1633	.85
1N5GT	.75		6SC7GT	.85		50L6GT	.65		3DP4	8.25		450TH	58.00		1634	.85
1N6G	.75		6SD7GT	.85		50Z7G	.75		3B24	5.25		464A	8.95		1641	2.45
1P5GT	.69		6SF5	.75		53	.60		3B24W	7.50		471A	1.95		1642	.85
1Q5	.68		6SF7	.75		54	1.35		3B26	3.75		GL473	165.00		1831	1.45
1R4	.69		6SG7	.75		56	.55		3B27	3.95		GL502A	1.50		2050	1.45
1R5	.65		6SH7	.75		70L7	1.35		3B29	14.95		WL530	17.25		2051	1.15
1S4	.58		6SH7GT	.75		71A	.55		3CP1	4.75		WL532	2.50		4130	3.25
1S5	.64		6SJ7	.65		75	.82		3C23	9.95		WL549	34.50		R4330	12.50
1T4	.65		6SJ7GT	.70		76	.55		3C24	1.95		WL559	1.25		R4410	15.00
1T5GT	.68		6SJ7Y	.90		77	.55		3C31	3.45		GL573A	19.25		5516	5.00
1U4	.67		6SK7	.70		78	.75		3C33	14.00		GL592A	33.00		5518	450.00
1U5	.65		6SK7GT	.72		79	.75		3C45	17.50		HY614	.75		5525	12.75
1V	.65		6SL7GT	.75		81	.60		3D23	2.35		GL627	22.00		5544	27.00
1X2A	.90		6SN7GT	.75		84	14.95		3E29	14.95		WL651	65.00		5545	5.00
1Z2	.75		6SN7GTA	.80		85	1.10		3FP7	2.95		F607	27.50		5550	14.00
2A3	1.10		6SN7GTW	2.25		86	.75		3FP7A	12.95		WL672	27.50		5551	75.00
2N2	.65		6SQ7	.80		89	.65		3JP1	17.50		GL673	21.75		5552	125.00
2X2A	1.55		6SQ7GT	.62		89	.25		3KP1	15.00		705A	2.35		5553	280.00
3A4	.65		6SR7	.90		101A	.90		3MP1	99.50		706UY	99.50		5554	225.00
3A5	.85		6SR7GT	.67		102A	.50		3UP1	27.00		708A	6.95		5555	125.00
3B4	.65		6SS7	.80		103A	.50		KC4	69.95		709A	1.75		5556	1.10
3Q4	.63		6ST7	.90		300B	3.75		KC4-3	59.95		713A	1.75		5557	7.25
3Q5GT	.75		6SU7GTY	2.70					4B24	6.50		714AY	12.50		5558	15.00
3S4	.70		6T7	1.85		**Transmitting**			4B26	7.75		715	5.00		5559	17.25
5T4	1.35		6T8	1.00					4C35	33.50		715A	6.25		5560	27.00
5U4G	.75		6V6	.75		OA2	1.10		4B27	17.50		715B	8.50		5561	39.00
5U4GW	2.35		6U5	.87		OA3	1.10		4J31	135.00		715C	22.50		5581	2.10
5V4G	.89		6U6GT	.85		OA4G	1.10		4J32	165.00		717A	1.25		5588	125.00
5W4	.79		6V6	1.30		OB2	1.30		4J33	145.00		718BY	89.50		5593	185.00
5Y3GT	.69		6V6GT	.67		OB3	1.15		4J52	195.00		719A	24.50		5610	.85
5Y4G	.65		6W4GT	.58		OC3	1.05		C5B			721A	6.50		5620	13.75
6A3	.75		6W6GT	.76		OD3	.95		5BP1	4.95		723A/B	19.95		5621	13.50
6A4	.65		6X4	.60		OE3	.95		5BP4	4.95		724A	2.25		5622	13.25
6A5	.95		6X5	.60		5C1	350.00		5CP1	3.95		724B	3.25		5623	13.50
6A6	.82		6X5GT	.60		VG1A	8.75		5CP7	12.50		725A	7.95		5624	13.50
6A7	.87		6Y6G	.95		1B21A	2.75		5C22	90.00		726A	14.50		5625	290.00
6A8	.68		6Z4	.75		1B22	2.10		5D21	17.50		726B	39.50		5626	22.00
6A8GT	.95		6Z5G	.60		1B23	8.40		5FP7	1.95		726C	92.50		5627	27.00
6A8S	.65		7A4	.75		1B24	9.95		5FP7A	12.50		5N729	3.45		5628	27.00
6AB5	.85		7A5	.75		1B26	2.95		5FP14	16.50		730A	28.95		5629	21.50
6AB7	.98		7A6	.75		1B27	18.75		5LP1	22.50		801A	.75		5632	12.75
6AC5	1.00		7A8	.75		1B29	2.45		5R4GY	1.75		802	4.75		5654	4.00
6AC7	.93		7AF7	1.05		1B32	1.95		5UP11	16.50		803	4.95		5662	1.15
6AD7	1.79		7B5	.75		1B33A	17.50		6BL6y	95.00		803A	13.50		5663	2.00
6AE5	.89		7B7	.75		1B36	16.75		6BM6	159.00		805	5.50		5670	7.00
6AF4	1.45		7C4	.75		1B37	19.95		C9J	7.95		807	1.69		5674	185.00
6AF6	.85		7C5	.75		1B38	59.95		6J4	6.95		807W	1.75		5683	250.00
6AG5	.80		7C6	.80		1B41	49.00		6K4	2.50		808	2.25		5684	5.25
6AG7	1.25		7C7	.75		1B42	10.00		7BP7	10.50		809	1.95		5691	7.45
6AH6	1.25		7E7	.75		1B44	37.50		10Y	.49		810	15.00		5692	7.45
6AJ5	1.15		7EZ8	.75		1B60	17.50		12DP7	17.50		811	2.95		5693	5.95
6AK5	1.30		7F7	.75		1B81	12.50		12GP7	17.50		811A	4.50		5718	8.00
6AL5	1.00		7F8	1.65		1B84	27.50		12HP7	17.50		812	2.75		5720	23.00
6AL6	.55		7H7	.75		1B90	17.50		C13	.60		812A	4.50		5725	8.00
6AL7GT	1.35		7L7	.85		1B93A	85.00		15E	1.75		813	13.50		5726	2.25
6AQ5	.85		7N7	.85		C1J	9.00		15R	.75		814	1.25		5727	4.00
6AQ6	.85		7S4	.95		1D21	3.25		FG17	5.25		813	2.95		5728	27.00
6AQ7GT	1.02		7V7	.89		1L21	15.00		RK20A	9.95		814	2.00		5739	49.95
6AR6	1.35		7W7	.95		1L22	30.00		24G	1.85		826	1.75		5740	89.50
6AS5	.75		12AF6	.65		1L23	30.00		FG27A	15.00		828	9.75		5742	14.50
6AS6	1.30		12AG6T	.65		1L24	40.00		FG28A	14.75		829	7.95		5745	34.50
6AS7	4.50		12AT	.90		1L25	16.00		FG32	15.00		829A	9.95		5749	2.95
6AT6	.60		12AL5	.65		1L31	16.00		FG33	23.00		829B	13.95		5750	4.50
6AU6GT	1.15		12AT6	.55		1L32	15.00		RK34	.95		830B	2.95		5751	3.75
6AU6	.73		12AU6	.70		1L34	15.00		35TG	4.25		832	2.95		5763	3.95
6AV5	.95		12AU6	.70		1L36	15.00		35TG	4.25		832A	9.95		5779	90.00
6AV6	.95		12AU7	.85		1L38	29.00		35T	7.50		833A	90.00		5797	12.75
6AV6GT	.55		12AV6	.60		1N21	1.25		RK39	14.50		834	19.00		5798	16.50
6AX4GT			12AW6	1.20		1N21A	1.95		RK48A	9.50		836	4.45		5834	5.75
6BA5	.63		12AX4	.90		1N21B	1.50		EF50	1.50		837	1.65		5845	3.95
6BA7	1.25		12BA6	.69		1N21C	17.50		5AK	5.95		838	2.65		5854	3.35
6BC5	.73		12BE6	.69		1N23	1.50		RK37	14.95		841	.85		5860	210.00
6BE6	.62		12BH7	.90		1N23A	2.50		QK59	65.00		842	5.95		5910	12.00
6BF6	1.10		12BY6	1.05		1N23B	3.50		QK62	65.00		845	.75		5844	2.25
6BF6	.72		12K8	.95		1N24	6.95		FG67	65.00		845	15.00		5855	95.00
6BG6G	1.59		12Q6	.69		1N26	6.95		CEQ72	.75		849	19.95		5896	7.50
6BH6	.90		12Z3	.50		1N34	.65		CEP72	.75		851	99.50		5902	30.75
6BJ6	.85		12J3GT	.50		1N34A	.95		RSR72	.85		852	27.50		5931	4.95
6BN6	.98		12N7GT	.75		1N36	.85		RSR73	.85		857B	225.00		5963	1.25
6BL7GT	1.25		12R8	.72		1N43	1.45		RK75	4.25		860	1.47		5965	2.25
6BQ6GT	1.20		12R8Y	.90		1N47	8.50		FG81A	9.75		861	37.95		5973	375.00
6BQ7	1.25		12SA7	.78		1N48A	1.00		FG95	27.50		864	.39		5978	350.00
6BR7	.95		12SA7GT	.79		1P21	53.95		FG97	25.00		866A	1.47		9003	5.25
6BS6	.75		12SC7	.85		1P22	2.75		FG98A	27.00		868	2.25		6011	12.75
6BR6	.75		12SF5	.75		1P37	2.70		M1100	69.95		869B	145.00		6044	42.00
6BT6	.95		12SF7	.75		1P39	1.00		100TH	18.95		872A	.75		6046	1.50
6C5	.60		12SG7	.85		1P40	1.75		100T8	1.95		874	1.25		6072	8.00
6C5GT	.60		12SH7	.68		1Q26	100.00		FG106	24.95		884	1.75		6081	1.75
6C6	.59		12SJ7	.65		1P41	5.50		FG105	24.95		885	2.00		6146	5.00
6C8	.85		12SK7	.75		2AP1A	10.50		114B	.85		889	1.70		6136	3.25
6CB6	.72		12SK7GT	.75		2B22	2.75		RK120A	9.25		889A	222.00		6137	3.25
6CD6G	1.85		12SL7	.75		2C21	.69		F124A	24.95		891	250.00		6291	5.25
6CH6	.72		12SL7GT	.75		2C22	.59		FG172	29.95		892	250.00		6292	.75
6E5	.79		12SN7GT	.75		2C26	.59		GL293A	5.50		905	3.95		8000	14.95
6E8	.65		12SQ7	.70		2C34A	.59		03D	1.25		920	2.35		8005	7.45
6F5GT	.62		12SQ7GT	.72		2C35	3.50		204A	59.95		927	2.45		8008	7.45
6F6	.79		12V6	.75		2C36	27.50		211	1.25		929	1.50		8013	2.35
6F6GT	.80		14F7	.85		2C39	24.50		CE213	2.50		931A	1.50		8013A	2.70
6F7	.85		14H7	.85		2C39A	13.75		217C	9.95		931A	5.25		8020	2.35
6F8G	.87		14N7	.85		2C40	15.95		GL215	225.00		932	5.25		8025	2.35
6G6G	.95		19HG6G	1.83		2C42	20.00		HA233A	5.95		935	7.45		8025A	10.00
6H6	.65		19T8	1.05		2C43	18.50		FG258A	79.50		934	.49		9001	1.65
6H6GT	.65		24A	.85		2C44	1.45		240A	6.50		935	.49		9002	1.35
6J5	.55		25A5GT	1.05		2C50	3.95		250TH	21.50		936	.49		9003	1.65
6J5GT	.55		25B6GT	1.05		2C51	7.50		250TL	18.95		957	.59		9004	.95
6J7	.90		25C6G	1.47		2C52	6.25		FG258A	235.00		959	3.95		9005	1.95
6J7GT	.60		25L6GT	.67		2D21	1.70		264C	3.25		991	.39		9006	.65
			25W4GT	.68		2G22	1.75		271 A	99.50		CK1005	.98			

Prices subject to change without notice. TERMS: Rated firms net 10 days, Non-rated 25% with order balance COD. Prices FOB Boston.

ELECTRO *Sales Company Inc.* (ESCO)

110 PEARL ST. BOSTON 10, MASS. Phone: LIBERTY 2-7890

INDEX
SEARCHLIGHT

October, 1952

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.02	400 DC	23F274	.39
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.045	15 KVDC	D-4495	9.95
.05	600 DC	S-4 Y	.25
.05	1000 DC	23F329	.49
.05-.05	600 DC	S-7	.49
.05-.05	600 DC	22F797	.49
.06	25 KVDC	26F385	17.50
.1	400 DC	481179	.45
.1	500 DC	KJ876543	.49
.1	600 DC	22F615	.59
.1	1000 DC	27F287	.65
.1	1500 DC	P70B1EM104K	.49
.1	3500 DC	KS204513	2.95
.1	7500 DC	25F695	3.95
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.1-.1	600 DC	27F291	.49
.1-.1-.1	400 DC	NCP5182	.79
.1-.1-.1	600 DC	CA-37	.79
.1-.1-.1	600 DC	6111G	.89
.1-.1-.1	600 DC	27J45	.79
.15	440 AC	6211288	.79
.15	4000 DC	4000815	2.95
.15-.15	6000 DC	26F435	3.25
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.2	440 AC	Lds. Mfg.	.69
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.2	10 KVDC	26F433	10.95
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.25	330 AC	6CE1A147	.79
.25	400 DC	D64025	.49
.25	440 AC	26F376	.79
.25	600 DC	26F431	.69
.25	1000 DC	62B1FG254K	.89
.25	1000 DC	27F255	.85
.25	1000 DC	25F412	.79
.25	1000 DC	25F413	.85
.25	2000 DC	481129	1.49
.25	2000 DC	TJU7900Z5	1.45
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.25-.25	600 DC	6027G	.79
.25-.25	600 DC	51B4FF254L	.99
.25-.25	600 DC	K7102919P1	.79
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.3-.3	1000 AC	25F560	1.95
.35	1000 DC	25F411	1.49
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.366-.127-.855	330 AC	25F483	.95
.375	330 AC	25F937	.79
.38-.38	330 AC	25F707	1.65
.4	800 AC	21F728	.79
.4-.4	800 AC	21F729	1.79
.4	1400 AC	25F934	1.79
.42	330 AC	25F731	.85
.44-.44	800 AC	21F484	1.79
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.5	330 AC	25F573	.69
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.5	600 DC	Lds. Mfg.	.79
.5	600 DC	Lds. Mfg.	.79
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1.0-1.0	600 DC	25F412	.79
1.0-1.0	600 DC	25F413	.85
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1.2	600 AC	21F711	1.65
1.25	440 AC	21F594	1.45
1.25	600 AC	21F593	1.45
1.25	600 AC	21F713	1.65
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2.6-0.4	440 AC	21F476	2.35
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2.75	330 AC	25F583	2.50
2.75	385 AC	25F16	2.69
3.0	330 DC	Lds. Mfg.	2.75
3.0	330 DC	25G30	2.75
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3.0-.05	330 AC	25F1632	1.95
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3.25	330 AC	25F475	3.45
3.5	330 AC	25F582	3.65
3.5	330 AC	25F581	3.65
3.5	330 AC	49F7	3.65
3.7	330 AC	21F705	3.65
3.75	330 AC	Lds. Mfg.	3.50
3.75	1000 DC	6037	3.75
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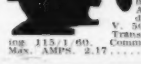

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IE-19—SCR-522 Test Set
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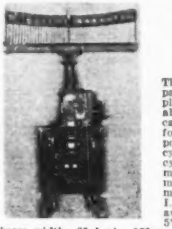
3Q5GT	.79	6J7	.95	12SQ7GT	.72
3S4	.74	6J7G	.60	12SR7	.72
3V4	.74	6K6GT	.65	14B6	.75
5NAGY	1.65	6K7	.79	14H7	.85
5Y3	1.12	6K8GT	1.15	14L6GT	.65
5U4G	.69	6L6	2.25	25Z5	.65
5V4G	.67	6L6G	1.50	25Z6GT	.68
5W4	.79	6L6GA	1.50	41	.69
5Y1GT	.49	6L7	.85	42	.75
5Y4G	.67	6N7GT	.85	45	.75
5Z3	.85	6R7	.79	50A5	.89
5Z4G	.95	6S4/3GT	.65	50B5	.75
6A3	.95	6SC7	.95	50C5	.67
6A6	.82	6SF7	.75	50L6GT	.68
6A7	.89	6SG7	.75	50Y6	.72
6AG7	.95	6SH7	.65	53	.68
6AB7	.98	6SJ7	.75	53	.82
6AC7GT	1.05	6SK7GT	.72	75	.82
6AG7	.95	6SL7GT	.75	80	.65
6AG5	.75	6SN7GT	.75	83	.95
6AG7	1.45	6SQ7	.65	83V	.92
6AH6	1.23	6SR7GT	.68	84/6Z4	.78
6AJ5	1.95	6S557	.80		

R·H·S
SPECIALS OF THE MONTH

RELIABILITY! HONESTY! SERVICE!

RADAR

APA-10—Panoramic Adaptor
APA-17—Automatic Direction Finder 250-1000 MC
APQ-5—Low Altitude Tracking & Bombing Equip.
APR-1—Radar Search Receiver 40-3400 MC
APR-2—Radar Search Receiver 85-1000 MC
APR-4—Radar Search Receiver 38-4000 MC
APR-5—Radar Search Receiver 1000-3100 MC
APR-6—Radar Search Receiver 3000-6000 MC
APS-2—S-Band Search Radar
APS-3—X-Band Search Radar
APS-4—X-Band Search & Homing Radar
APS-6—X-Band Search & Gun Laying Radar
APS-15A—X-Band Blind Bombing Radar
APR-4—Radar Jamming Xmitter 155-780 MC
APT-5—Radar Jamming Xmitter 350-1400 MC
SO-13—S-Band Marine Radar, Lightweight
SQ-10 CM Portable Radar
TPS-1—Portable Search Radar
TPS-3—L Band Search Radar
UPN-1 & 2—S-Band Portable Beacon Battery or 110v AC



SQ 10 CM PORTABLE RADAR

This set is a very compact search radar. Complete installation available. New in carrying cases. Tech. data as follows: power input: 90-130v cy cyc.; pulse rate: 800 cyc.; range: 3, 15, 45 miles; pulse width: 1 microsec.; 300 yds. min. range, all ranges; I.F.F. synch. output available; accuracy ±5°; power output 1 KW; beam width: 8° horiz. 15° vert.; presentation: A, B, P.P.I.

MOBILE POWER PLANT

(GAS DRIVEN)

Output: 220v—3KW—60 cyc. One phase. Excellent condition, checked out.

RA-34—Power Supply for BC-375E
RA-62—Power Supply for SCR-522
BC-1016—Ink Tape Recorder
PE-103—Dynamotor Power Supply
PE-104—Vibrator Power Supply
GN-58—Hand Cranked Generator W/Legs & Seat
SCR-578—Gibson Girl (Emergency Xmitter)
CRT-3—Victory Girl Dual Freq. Emergency Xmitter Sound Powered Chest & Headsets MI-2454-B; Type O, Mfg. RCA.
AS-32/APX-1—Antenna
ANICRC-7—V.H.F. Handi-Talkies 112MC Xtal Controlled
MN/26-Y—Compass Receiver
BC-733D—Receiver with Tubes
C-3—Navy Snooperscope in Carrying Case
BC-1284—Lighthouse Tube Preamplifier
BC-996—Interphone Amplifier
RL-42—Motor Antenna Reel
30 MC—I.F. Strips Using 6AK5
RD-7/APA-23—Receiver for APR
AS-27/ARN-5—Antenna
ARA—Receiver—500-1500 KC
ID/80-APA-17—Indicator
R-28/ARC-5—Receiver—100-156 MC
RM-29—Remote Control
BC-455—Receiver—6-9 MC
BC-454—Receiver—3-6 MC
BC-800—Transmitter/Receiver
BC-950—Transmitter—100-156 MC
RA-300—FM Exciter (Mfg. Tempco)
FL-8—Filter
FL-5—Filter, Less Cables
3C-16-D GSAP—Gun Camera Computers with All Accessories; in Carrying Case
AT-2A/APN-2—Antenna

SPARE PARTS AND COMPONENTS AVAILABLE FOR MANY EQUIPMENTS

ALL EQUIPMENT SOLD IS CAREFULLY RECONDITIONED AND CHECKED OUT TO ORIGINAL SPECIFICATIONS IN OUR OWN SHOPS USING FINEST LAB TYPE TEST EQUIPMENT.

THESE COMPLETELY EQUIPPED SHOPS AND OUR EXPERIENCED TECHNICAL STAFF ARE AVAILABLE FOR GOVERNMENT PRIME OR SUB-CONTRACT WORK OR PRIVATE COMMERCIAL ORDERS ON ANY TYPE OF COMMUNICATIONS OR RADAR APPARATUS.

PANEL METERS

2" SQUARE WESTON—SANGAMO

0-20 Volts D.C.	$2.95	0-5 Ma	$2.95
0-40 Volts D.C.	2.95	0-500 Microamp.	4.95
0-.5 Amp. R.F.	2.95	0-100 Ma (0-300 scale)	2.95

COMMUNICATIONS

AN/ARC-1 TRANS/REC.

Provides Radio-Telephone Communication between Aircraft or Aircraft and Ground. Complete with Shock Mount and Control Box. Input: 28V DC. Excellent condition. Available in either 10 or 20 Crystal Controlled Channels 100-156 MCS.

APA-11—Pulse Analyzer
APN-1—Airborne Radio Altimeter
ARC-4—VHF Transceiver 140-150 MC
ARN-5—Glide Path Receiver
ARN-7—Airborne Directional Finder
ARR-2—Homing & Receiving Equipment
ART-13—Collins Autotune Transmitter
BC-223—30-Watt Transmitter 2-5.2 MC
BC-342—Receiver—1.5 to 18 MC 110v AC
BC-348—Receiver—1.5 to 18 MC 28v DC
BC-375E—Radio Transmitter
BC-639—VHF Receiver 100-156 MC
BC-640—VHF Transmitter 100-156 MC
BC-1206—Beacon Receiver 200-400 KC
RC-103—Airborne Localizer Receiver
SCR-269—Radio Compass
SCR-274N—Command Equipment
SCR-284—Field Radio Station
SCR-291—Semi-Portable Direction Finder
SCR-300—Field Transmitter and Receiver
SCR-522—VHF Transmitter and Receiver
SCR-536—Handi-Talkie
SCR-555—Semi-Portable Direction Finder
SCR-694—Portable Field Transceiver
SCR-625—Mine Detector
SCR-718A-AM-C—High Altitude Altimeter
T-50—Radio Telegraph Transmitter
TCS—Marine Telephone Transceiver

XMITTING TUBES

0A3/VR75	$1.04	15R	$0.69	866A	$1.15
0B3/VR90	1.39	28D7	1.95	866JR	1.29
0C3/VR105	1.19	30 Sonc	.45	865JR	$1.00
0D3/VR150	.95	35T	1.25	872A	2.95
1B23	9.75	45 Sylv	.75	875	1.19
1B24	9.75	100TH	7.95	878	1.59
1B27	14.95	211	.65	881	1.39
1B29	2.45	250TH	19.95	882A	1.59
1M21B	3.25	260TL	17.95	915	1.10
1N23	1.25	262B	1.95	923	.75
1N23A	2.39	274B	2.95	922	.95
1N23G	3.69	304TL	8.95	927	1.95
1N34	.75	307A	2.95	930	.95
1N34A	.97	307A/RK75	3.95	931A	4.45
2AP1	19.95	316A	.75	954	.25
2C40	7.50	328A	8.95	955	.25
2C43	14.95	340B	4.95	956	.25
2C44	3.19	350B	3.95	957	.29
2C45	7.95	357A5	7.95	958	.49
2C46	6.25	371A	.95	985	3.95
2D21	1.35	371B	.69	9D1/ME16	.75
2E22	3.75	372A	2.95	1613	7.95
2E24	4.45	394A	3.95	1613	.39
2E26	3.15	417A	3.95	1619	.69
2K28/723AB		434A	27.50	1619	.24
	28.75	446A	1.95	1622	2.45
2K28	32.50	446B	3.75	1624	3.45
2K31A	310.00	575A	15.75	1626	.25
3AP1	9.95	700A	9.95	1628	.25
3B24	5.25	703A	5.25	1629	.25
3B24W	7.95	705A	7.95	1630	.25
3B26	3.59	707B	13.95	1632	.72
3BP1	6.95	707W	7.95	1638	.45
3C22	115.00	715A	6.39	1851	1.65
3C24/24G	4.75	715B	8.75	1852	1.75
3C45	15.95	715C	15.95	5670	6.95
3CP1	1.95	717A	.98	8008	5.95
3CP1S1	1.95	721A	2.45	8012	.40
3DP1	4.45	723A	9.50	8013	2.65
3DP1A	4.45	723A/B	19.95	8020	.98
3DP1-S2A	6.95	724B	3.25	8020	.98
3DP1A	4.75	726A	39.95	9001	1.50
3E29	13.95	800	18.75	9002	.98
3FP7	1.65	810A	29.95	9003	1.65
3GP1	4.75	806	1.15	9004	.75
4-125A	27.50	802	3.95	9005	1.45
4-250A	37.50	803	3.25	9006	.27
4AP10	4.45	804	11.75	C1JA	9.95
4C35	27.50	805	11.75	C4A	7.95
4D21	14.95	806	24.95	C6J	6.15
5AP1	3.45	807	1.59	CK1005	.48
5BP1	3.45	808	2.45	F123A	7.75
5BP1	4.45	810	9.50	F127A	27.50
5BP1	4.45	811	2.95	F128A	89.50
5CP1	4.59	812	2.75	FG17	4.89
5CP7	4.75	813	12.75	FG27A	4.95
5D21	15.95	814	2.69	FG32	6.95
5FP7	1.85	815	2.35	FG57	14.95
5JP1	4.45	816	2.45	FG81A	3.49
5JP1	24.48	826	.69	FG105	17.95
5JP2	22.50	828	5.95	HF100	11.50
5LP1	22.50	829	10.95	GL434A	28.95
5NP1	5.50	829B	12.95	HF200	2.79
6AN5	1.30	830B	2.75	HF300	5.95
6AS5	2.50	832	6.75	HY1140	22.95
6AS7	4.45	832A	8.50	HY114B	.69
6C21	21.80	836A	3.49	HY115	.69
6J4	6.75	837	3.45	HL101	47.50
7BP7	6.55	838	2.25	REL21	1.95
7DP4	14.50	845W	4.75	RK60/1641	2.25
7LP7	4.95	849C	27.50	RK62	26.50
100P4	17.45	851	47.50	RK72	.48
12D	.39	860	47.50	VT127A	2.45
12DP7	14.75	861	22.50	WL616	34.50
15E	1.35	865	.98		

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TRANSFORMERS

All 115 V 60 Cyc Input Tv & CW Pwr Xfmr up to 20% Tubes. Hi VOLTS to 500V (w/quadrupler 1½A) ALL Tubes 6.3V, 4 FIL wndgs @ 3.0A. 2.5VCT/2.5A. 6.3VCT/2A. 6.3VCT/3A. 6.3VCT/4A. 6.3VCT/6A. 6.3VCT/8A. 6.3VCT/10A. 6.3VCT/12A. 6.3VCT/15A. 6.3VCT/20A. 6.3VCT/30A. 6.3VCT/40A. 6.3VCT/50A. 6.3VCT/60A. 6.3VCT/75A. 6.3VCT/100A. 6.3VCT/120A. 6.3VCT/150A. 6.3VCT/200A. 6.3VCT/250A. 6.3VCT/300A. 6.3VCT/400A. 6.3VCT/500A. 6.3VCT/600A. 6.3VCT/750A. 6.3VCT/1000A. 6.3VCT/1200A. 6.3VCT/1500A. 6.3VCT/2000A. 6.3VCT/2500A. 6.3VCT/3000A. 6.3VCT/4000A. 6.3VCT/5000A. 6.3VCT/6000A. 6.3VCT/7500A. 6.3VCT/10000A. 6.3VCT/12000A. 6.3VCT/15000A. 6.3VCT/20000A. 6.3VCT/25000A. 6.3VCT/30000A. 6.3VCT/40000A. 6.3VCT/50000A. 6.3VCT/60000A. 6.3VCT/75000A. 6.3VCT/100000A. 6.3VCT/120000A. 6.3VCT/150000A. 6.3VCT/200000A. 6.3VCT/250000A. 6.3VCT/300000A. 6.3VCT/400000A. 6.3VCT/500000A. 6.3VCT/600000A. 6.3VCT/750000A. 6.3VCT/1000000A. 6.3VCT/1200000A. 6.3VCT/1500000A. 6.3VCT/2000000A. 6.3VCT/2500000A. 6.3VCT/3000000A. 6.3VCT/4000000A. 6.3VCT/5000000A. 6.3VCT/6000000A. 6.3VCT/7500000A. 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Infrared Snooperscope

Image-Converter Tube Hi-Sensitivity simplified design 2" dia. Willemite screen—Resolution up to 300 lines/in. Complete data & tube, ea. ..... **$4.98; 2 for $9.45**

SNOOPERSCOPE PWR SUPPLY

1800VDC/35 MA, Using Doubler Vrkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram 115V/60cy Oper. **$6.98**

UHF ANTENNA

UHF ANTENNA 12"/30CM ATS/ARR1 Usable Cltn & Ham Band Ins. Coax Term Silv Pl Cont Gask & H'ware Multip Mtg. . . **39c; 4 for $1.00**
PL259 for above ..... **.65**
TV CONICAL ANTENNA Sturdy Prefab Incl. 6 elements & 100 ft. Copper Twinex Cross Bar & Hardware Brand New **$6.25**
MICROWAVE ANT AS125/APR. 1000 to 2400 Mc w/UG58U Term InBuilt HiPass Flt: Flange Mtg Incl. H'ware **$5.98**

MERCURY THERMO REGULATOR

DUAL CKT. 105°F & 225°F. Extremely sensitive & accurate for most exacting requirements—Research, Fire Prev., Freeze, Pr Control, or Max-Min Temp's Control. Brand New. Individ. Boxed w-data & ckt.
SPECIAL Ea. 98c: ..... 12 for $10.00

ONE YEAR GTD TV PICTURE TUBES

10 inch Round	$14.95
12 inch Round	17.95
14 inch Rectangular	20.95
16 inch Round	22.95
16 inch Rectangular	23.85
17 inch Rectangular	24.85
19 inch Round	28.50
20 inch Rectangular	29.95
21 inch Rectangular	38.45
24 inch Metal	67.00

Your old pict. tube is worth money, write for trade-in-allowance toward RMA coded and dated tubes with one year guarantee. Ship your defective picture tubes prepaid only.
When ordering metal tube, defective metal tube is required.

"TAB"
THAT'S A BUY

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6 Volt WILLARD Mini-BRAND NEW; 8 os Designed Portable Equip Models . . . **98c; 4 for $3**
36V, 4 Batteries W/Acid **$5.35**
2V 20AH Willard PLUS 2V Vibrator **$2.98**
6V, 6AH Wilid NTE/BH214U **2.98**
6 Volt 6AH Batteries W/Acid **2.45**
6V/40AH Willard **6.98**
6 Volt 40AH Battery W/Acid **6.98**
Battery Acid, (R-Exp) 1 pt. **59c;** 2 pts. ..... **.98**
Hydrometer 1.06 to 1.24 Sp Grav **1.98**
Spec Grav Ind & Merc. Thermom. ..... **.98**
2V/20AH, w/Vib & Acid **3.55**
We Ship R'Exp Only

TUBE CLAMPS

926B-5 926B-16, 926B, 929-1, 930-19, 926B-19, 926A-10 ..... **5 for $1.00**

"TABS" TUBE SPECIALS
BROKEN KEYS—ELECTRICALLY PERFECT

1B3GT, 5R6, 6K8GT, 6S7GT
12SN7GT ..... **Each 98c; 5 for $2.00**
6BG6G, 6BQ6GT, 12BG7, 19BG6, 6L6G, 6L6GA ..... **Each 79c; 3 for $2.00**

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831B/SO239 Receptacle **$0.50** ..... **10 for $3.90**
831B/PL258A Plug **$0.65** ..... **10 for 5.50**
831B/PL259 Plug **$0.60** ..... **10 for 4.75**
83-1J/PL258 Junction ..... **.95**
CORD C207A **W/PL259 & PL258 5 ft** long. . . **1.09**
CORD same as above **5 ft 95 $1.29; 12 ft** long. **1.49**
CORD RG8U COAXIAL CABLE per ft ..... **.22**
CORD RG11U 5 foot lengths per ft ..... **.08**
CORD CO277 6/CNDTR, P/O DC312 ..... **1.89**
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300 Ohm Copper Twinex per ft **2c; 1M ft $12.98**

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PUSH TO RESET

Amps 3-5-7-10-15-20 Ea. **20c**
4 for **$1.**; 25 for **$5.**; 100 for **$15.**
Circuit Breaker Fuse W/2 Mounting Clips **39c;** 3 for . . . **$1.00;** 20 for . . . **$6.98;** 100 for . . . **$25.**
Fuse in 3AG Size. Operates up to 24 Volts

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2 ohm 50W Model J **$2.59**
6 ohm 25W Model LH **1.98**
15 ohm 75W Model LH **3.74**
60 ohm 40W w/knob **2.69**
100 ohm 50W Model K **2.25**
740 ohm 25W **1.98**
800 ohm 200W Model P **6.49**
350, 500, 3000 ohm Slotted shaft, 25 watt ..... **ea. 1.39; 4 for 5.00**
1000 ohm 25W Model J ..... **79c; 3 for 2.00**
Write for Special Prices on 5 Pcs & Up

POTENTIOMETERS—Type J

5 ohm Type J ¼" shaft . . . **93c**
200 ohm Type J ¼" Slotted shaft **93c; 12 for $10.**
1000 ohm Type J ¼" shaft . . . **93c; 12 for $10.**
3500 ohm Type J ¼" shaft . . . **93c; 12 for $10.**
7K ohm Type J ¼" Slotted shaft **93c; 12 for $10.**
25K ohm Type J ¼" Slotted shaft **93c; 12 for $10.**
50K ohm Type J ¼" shaft . . . **93c; 12 for $10.**
100K ohm Type J ¼" shaft . . . **93c; 12 for $10.**
1 meg Type J ¼" Slotted shaft **93c; 12 for $10.**
1 meg Type JJJ (Triple) 1½" shaft **3.6,**

866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cy Input, output 2.5vct, 10A/Heinsul **$6.98**

DIODE PROBE TUBE

Unexcelled for **Ne-Less VMF** testing. Ultra-sensitive submini type envelope. **New,** w/data VR92 ..... **25c; 5 for $1.**

Selenium Power Supply

0 to 12VDC/2 Amp. Variable DC supply, uncased and completely built—input, 115c/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. **Ideal** for new "HO" locomotives **$18.95**
2 for $20.00

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We specialize in Rectifiers and Power supplies to your specifications. Immediate delivery.

Current (cont.)	18/14 Volts	28/18 Volts	30/28 Volts	24/40 Volts	130/100 Volts
2AMP	2.70		3.60	6.30	10.50
4AMP	3.75		5.00	8.50	
6AMP	4.95		7.95	12.95	27.00
10AMP	7.95	9.98	12.00	20.00	48.00
12AMP	8.50		16.00	25.50	50.00
20AMP	12.95	16.20	24.00	36.00	68.00
24AMP	16.00		31.00	39.50	98.00
30AMP	18.50	24.50	36.00		
36AMP	25.50		46.00		

C. T. Rect 100 amp 18-0-18V **$35.00**
Full Wave Selen Rect & Trans: in Kit Form. All 115V/60cy inputs
up to 24VDC at 12 amps 23.98
up to 28VDC at 12 amps 31.98
up to 28VDC at 48 amps 649.50
up to *20VDC at 6 amps 12.98

* This 6 amp supply has no saving taps.

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18.8—19.2—20.4—21.4 Volts/12 Amp	$14.98
31—32—34—36 Volts/12 Amp 2 Kvins	14.98
18—12—9—CT—9—12—18V/4 Amp	8.75
31—32—34—36 CT—9—12—18V/12 Amp	16.75
31VCT—24V—18V/24 Amp	28.75

TOGGLE SWITCHES

SPST GE BKLT CSD 3A/250V **35c;** 5 for **$1.**
SPDT AHR BKLT CSD 3A/250V
35c; 4 for $1.
SPDT BKLT CSD Momentary **89c; 3 for $2.50**
DPST BKLT CSD 15A/125V. **89c; 3 for $2.50**
DPST CH CSD 3A/125V ..... **89c; 3 for $2.50**
DPST BKLT CSD 20A/250V. **1.25; 3 for $3.25**
DPDT AHR Laminated **69c; 3 for $1.90**

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PRICES SUBJECT TO CHANGE

0A2	.99	2E26	3.19	6A7	1.32	6SF5	.89	12AX7	.79
0A3/VR75	1.25	2E30	2.19	6AQ7	1.09	6SF7	.89	12AY7	2.95
0A4G	1.45	2E31	2.49	6AB1	.79	6SG7	1.39	12AZ7	1.49
0B2	1.37	2E36	2.19	6AB5/6N5	1.33	6SH7	.79	12BA6	.79
0B3/VR90	1.09	2E41	2.39	6AB7/1853	3.39	6SJ7	.79	12BE6	.79
0C3/VR105	1.19	2E42	1.39	6AC7	1.49	6SK7	.79	12BH7	1.49
0D3/VR150	.98	2G21	2.39	6AC8G	1.49	6SL7GT	.89	12BR6	2.98
0Y4	2.53	2J21	10.75	6AC7	.99	6SN7GT	.89	12BY7	2.98
0Z4	.69	2J21A	8.90	6AD6G	.98	6SN7GTA	2.75	12BY7A	3.98
1A3	1.19	2J26	3.98	6AF4	1.49	6SQ7GT	1.09	12C8	1.49
1A4P	.79	2J32	27.45	6AH6G	1.49	6SR7	.89	12CR6	1.49
1A5GT	.79	2J33	27.45	6AJ5	1.49	6SS7	.89	12DT7	2.98
1A6	1.49	2J34	27.25	6AJ5	1.49	6ST7GT	1.98	12E1	3.98
1A7GT	1.39	2J36	12.75	6AK5	1.74	6SL7GT	.89	12E6	2.98
1AD4	2.98	2J37	12.70	6AL5W	2.98	6SN7GT	.89	12F8GT	1.49
1AE4	1.89	2J38	11.75	6AK5	1.06	6SN7WGT	2.75	12H6	.89
1LC1B/1C31	1.98	2J39	14.00	6AQ5	.94	6SQ7GT	1.25	12K5	1.49
1B3/8016	.81	2J42	250.00	6AL7GT	1.29	6SR7	.79	12K7GT	1.49
1B4P	.98	2J48	14.25	6AQ5	.35	6S57	1.12	12C8	1.49
1B5/25S	.99	2J49	14.00	6AQ5	3.98	6SU7GT	1.32	12H6	.89
1B7GT	.89	2J50	21.75	6AS6W	1.29	6SU7GTY	1.32	12H6	.89
1B21/471A	2.85	2J52	249.50	6AQ6	.89	6SY7	1.49	12J5GT	1.49
1B22	3.28	2J55	85.00	6AQ7GT	1.29	6T7G	.89	12J7GT	.79
1B23	3.28	2J56	160.00	6AR5	.89	6T8	1.09	12K7GT	1.49
1B24	17.49	2J61	49.95	6AR6	2.98	6U5/6G5	.89	12K8	.79
1B26	2.98	2J62	49.45	6AS5	.79	6U6GT	1.09	12Q7GT	1.49
1B27	14.98	2K22	49.95	6AS6	2.65	6U7G	1.09	12Q7GT	1.49
1B35/532A	.98	2K25	39.95	6AS6W	2.98	6V3	1.09	12SA7GT	.85
1B38	18.98	2K25	39.95	6AS7G	4.35	6V6	1.25	12SC7	1.49
1B40/723AB	14.98	2K26/723AB	18.00	6AT6	.63	6V6GT	.57	12SF5GT	.79
1B41	29.95	2K28	32.00	6AU5GT	1.49	6W4GT	.57	12SF7GT	.79
1B48	4.95	2K29	22.95	6AU6	.99	6W6GT	1.09	12SH7	.79
1B52	49.45	2K33	300.00	6AV5GT	.89	6W6GT	1.09	12SH7	.79
1B62	18.00	2K35	398.00	6AV6	.89	6W6GT	1.09	12SH7	.79
1B63	3.98	2K36	1495.00	6AW6	1.49	6X4	.89	12SK7	.79
1B83	49.95	2K41	145.00	6AX4/GU4	.79	6X5GT	.79	12SN7GT	.79
1B84	18.00	2K42	145.00	6AX5GT	.79	6Y6G	1.29	12SN7GT	.79
1B85	350.00	2K43	135.00	6BA6	1.22	6Z3	.89	12SQ7GT	.79
1B86	69.75	2K46	360.00	6BS	.79	6Z7G	.89	12SR7GT	.79
1B87	50.00	2K47	460.00	6BG6G	1.19	6ZY5G	.89	12X5	.79
1BG1A	75.00	2K48	118.00	6B7	1.19	7A4/XXL	.89	12X5	.79
1C1C	2.79	2V3G	1.29	6BA6	.63	7A5	.99	14A4	1.09
1C5GT	.89	2W3GT	.98	6BA6	.63	7A6	.79	14A7/12B7	.99
1C6	1.27	2X2	1.59	6BC5	1.27	7A7	.99	14AF7/XXD	1.19
1C7G	.89	2X2A	1.89	6BC5	.63	7A8	.89	14B6	.99
1D5GP	.99	3A4	.99	6BC7	1.23	7B5	.89	14B8	.99
1D7GT	.89	3A5	1.49	6BD5GT	1.65	7B6	.79	14E7	1.09
1D8GT	1.49	3A8GT	1.59	6BD6	.83	7B7	.79	14F7	1.09
1D21/631P1	1.98	3B4	2.69	6BE6	.79	7B8	.79	14F8	1.29
1E5	.98	3B7/1291	.69	6BF5	.98	7C5	.98	14Q7	.99
1F4	2.70	3B22	2.70	6BG6G	1.49	7C6	.79	14S7	1.09
1F4	.69	3B23/RK22	4.95	6BF7	2.55	7C7	.69	14S7	1.09
1F5G	1.49	3B24	2.49	6BG6G	2.15	7AM7	1.15	14E5	.99
1F5	.89	3B25	4.50	6BH6	1.49	7B4	1.09	14E7	1.09
1F7G	.89	3B26	3.70	6BH6	.63	7B5	.79	14F7	1.09
1G4GT	.89	3B28	3.70	6BJ6	1.49	7B6	.79	14F8	1.29
1G5G	.89	3C6/XXB	1.49	6BK7	2.15	7B7	.79	14H7	1.09
1G6GT	.89	3C22	95.00	6BL7GT	1.49	7B8	.89	14J7	.79
1H4G	.89	3C23	12.45	6BN6	1.49	7B8/1203A	.79	14JH7	1.49
1H5GT/C1B	1.49	3C24	4.98	6BQ6GT	1.49	7C5	.98	14Q7	.99
1J6	.79	3C33	14.98	6BN6GT	1.49	7C6	.79	14S7	1.09
1J5G	1.20	3C34/HK24	4.49	6BQ7	2.15	7C7	.69	14S7	1.09
1J6GT	.89	3C45	17.50	6BW6G	1.49	7E5/1201	1.25	15E	.89
1L4	.69	3D6/1299	.69	6L5C/6C	16.98	7E6	.89	RK59	.99
1L6	1.49	3D21A	4.98	6C4	.60	7E7	.89	FG17	.99
1LA4	1.19	3D22	13.95	6C5GT	.79	7F5/1201	1.25	15E	.89
1LB4	1.19	3E22	14.95	6C6	.79	7F6	.89	15E	.89
1LB6	1.29	3E29	14.95	6C7	1.26	7F7	1.25	18	.89
1LC5	.79	3K22	275.00	6C8G	29.45	7F8	2.19	19	.89
1LC6	1.39	3K29	275.00	6C8G	.69	7G7/1232	1.29	19BG6G	1.98
1LD5	.99	3K30	300.00	6CB6	.69	7H7	.89	19T8	.89
1LE3	.98	3LF4	1.35	6CD6G	2.70	7J7	1.09	19V8	1.29
1LH4	.89	3Q4	.79	6D4	2.70	7J7	1.09	19Y3	1.29
1LN5	1.09	3Q5GT	1.29	6D6	.89	7K7	1.29	T20/1623	1.29
1N5GT	.99	3S4	.85	6D7G	.89	7L7	1.19	TUP20	1.19
1N6GT	.79	3V4	.89	6DE6	.89	7N7	1.19	TZ20	1.19
1P4T	5.00	4-125A	29.95	6E5	.89	7Q7	.79	20	.89
1Q5GT	.89	4-250A	49.95	6E6	2.65	7R7	.99	RK20A	6.95
1R4	69.00	4-1000A	188.50	6E7	2.65				
1R4/1294	1.25	4B21	16.98	6F4	6.35				
1S4	.89	4C35	4.98	6F5	.99				
1S4	1.19	4C35/HK54	5.98	6F6	.99				
1S5	.79	4C39	59.00	6F6GT	.99				
1S21	7.90	4C51	27.25	6F7	1.29				
1T4	.79	4C50	15.50	6F7G	1.29				
1T6GT	.89	4E27/257	3.98	6F8G	1.49				
1U4/5910	.75	4J22	148.50	6H6	.89				
1V	.79	4J31	398.00	6J5	1.09				
1V	.79	4J34	398.00	6J6	7.69				
1V2	.79	4J42/700	27.25	6J6GT	.89				
1X2	.95	4J47	260.00	6J5	1.09				
1Y2	6.98	4J47CY	350.00	6J7	1.09				
2A3	1.78	4T4.2	5.95	6K4	5.15				
2A3/G	1.98	4X-150A	45.00	6K6GT	6.45				
2A5	.69	4X-500F	85.00	6K8GT	1.09				
2A6	.89	5AX4GT	1.49	6K7	.85				
2A7	.69	5AZ3	1.35	6K7	1.49				
2AC15	4.98	5B/563	1.98	6L6	1.49				
2AF15	4.98	5B/5C30	1.98	6L6G	1.49				
2B7	.89	5C21/C6J	6.95	6L6	2.09				
2B22	3.98	5C22	2.49	6L6G	1.69				
2C21/1613	.67	5C31/C3B	1.95	6L6GA	1.69				
2C22/7193	.79	5D21	1.95	6L6GAY	1.69				
2C26	.15	5D23/RK65	16.50	6L7	1.19				
2C34	.79	5J22	2.49	6N6	1.39				
2C34/RK34	.69	5R4WGY	1.75	6N7GT	1.29				
2C39	.79	5T4	1.49	6Q7GT	.89				
2C40	9.98	5V4G	.55	6Q7	.89				
2C43 JAN	10.98	5V4G	1.10	6R7	.89				
2C44	26.75	5W4	.85	6R8	1.39				
2C45/464A	9.45	5X4G	.79	6S8	.98				
2C46	1.20	5Y3GT	.43	6S7G	.89				
2C50	3.69	5Y4G	.79	6S8GT	.99				
2C51	6.45	6F8	.89	6SA7GT	.89				
2C52	5.98	6Z4	1.49	6SA7GT	1.37				
2D21	1.49	6A4	6.75	6SA7GTY	1.19				
2E5	1.15	6A3	1.59	6SB7Y	1.39				
2E22	1.95	6A4	2.49	6SC7	1.39				
2E25/HY65	5.15	6A5	.89	6SD7GT	.99				

TUBES "TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

7A7	.99	14AF7/XXD	1.19	RK49	7.50	274B	3.45	710A/8011	.95
7A8	.89	14B6	.99	49	.89	276A	9.85	713A	.98
7AD7	1.45	14B8	.89	50	1.03	T 100	14.75	714A	6.95
7AF7	.89	14C5	1.09	50A5	1.15	304TH	8.90	716AY	5.90
7AG7	1.09	14E5	1.09	50B5	1.29	307A	14.75	716A	5.90
7AH7	1.15	14E6	.99	50C5	.69	307A/RK75	4.85	715B	8.90
7B4	1.09	14E7	1.09	50L6GT	1.49	310A	4.95	715C	8.90
7B5	.79	14F7	1.09	50L6GT	.69	311CH	10.95	717A	3.45
7B6	.79	14F8	1.29	50X1	.89	311CT	10.50	718BTY	48.45
7B7	.79	14H7	1.09	50X6	.79	311C	10.50	719AY	48.45
7B8	.89	14J7	1.19	5027G	.98	311G	2.98	719A	49.95
7B8/1203A	.79	14JH7	.99	51	.59	312A	14.49	721A	5.98
7C5	.98	14Q7	1.09	53	.60	322A	24.25	722A/287	2.45
7C6	.79	14S7	1.09	Y35	1.89	323A	24.25	723A	5.98
7C7	.69	14S7	1.09	55	1.06	5340	2.98	723A/B	25.00
7C25	72.00	14W7	1.09	56	.85	350A	6.50	724A	3.95
7C29	69.95	14X7	1.21	57	.79	350B	6.50	724B	3.95
7E5/1201	1.25	15E	1.98	58	.79	353A	4.65	725A	8.90
7E6	.89	15E	1.45	RK58	1.45	RK 354	24.50	726A	8.90
7E7	.89	FG17	9.95	59	1.78	355A	14.15	726B	89.95
7F7	1.25	18	1.98	RK60/1641	1.95	368AS	7.75	730A	19.95
7F8	2.19	19	.69	RK61	3.05	371B	.98	800	2.85
7G7/1232	1.29	19BG6G	1.98	75	10.49	388A	.79	801A	.45
7H7	.89	19T8	1.09	RK75	4.50	394A	1.49	803	3.98
7J7	1.09	19V8	1.62	70AT	1.59	393A	8.90	803	5.98
7K7	1.29	T20/1623	1.29	70AT/GT	1.59	394A	8.90	804	13.50
7L7	1.19	TUP20	1.19	71A	.79	FP400	15.98	805	3.00
7N7	1.19	TZ20	1.19	75	1.26	WE417/5842	15.98	806	3.00
7Q7	.79	20	1.17	CRP75	1.49	417A	8.95	808	2.50
7R7	.99	RK20A	6.95	75	1.67	GL434A	24.98	809	2.43

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7S7	1.09	RX21	3.75	MY75	4.59	446A	1.95	810	9.95
7Y4	1.03	22	.99	75	.99	446B	3.85	811	2.90
7V7	1.19	24	1.98	76	.69	450TH	64.00	811A	3.75
7W7	1.19	24A	1.10	77	.69	450TL	52.00		
7X7/XXFM	1.19	24G/1C24	1.90	78	1.05	460/HF200	18.95	812	2.70
7Y4	.69	25A6	.99	79	.69	500A	3.95		
7Z4	.69	25A7	2.98	80	.69	GL471A	3.65	814	3.45
8DC-15	4.98	25AC1GT	1.49	80	1.69	GC5081X	1.26	816	3.45
10Y	.43	25AV1GT	1.29	FG81A	1.90	GC5081AX	1.26	816/866Jr.	1.07
11CV11	.69	25B6GT	1.15	82	1.19	GL502A	1.79	826	1.98
12A	.89	25C6	1.19	82	1.19	CK5082AX	1.79	828	15.25
12A6	1.39	25L6GT	.69	83	1.45	CK5083AX	1.79	5D828	.98
12AC6	.89	25W4GT	.89	83V	1.45	CK5084AX	1.79	829B	13.49
12AE6	1.29	25Y5	.79	84/6Z4	.99	CK5086AX	1.79	829B	12.45
12AH7GT	1.49	25Z5	.79	85	.79	5007	1.45	832	14.50
12AC7	1.45	25Z5GT	.99	85	.75	CK5089AX	1.26	832	7.65
12AH7GT	1.45	26	.79	VR85	.75	CK5122AX	1.26	832A	9.45
12AK5	1.98	27	.69	FG85/5560	24.85	CK522AX	1.49	833A	49.95
12AL8/6SW	1.29	FG27A	8.70	VR90	19.95	CK525AX	1.15	834	3.95
12AL5	.61	MY27	10.95	100TH	8.85	CK526AX	1.15	836	1.98
12AT6	.52	RK28A	4.89	102D	2.98	CK527AX	1.49	837	1.45
12AT7	.52	28D7	4.89	103	2.98	CK528AX	1.49	838	1.45
12AU6	.72	30	.70	FG104	37.98	CK529AX	2.98	843	1.95
12AU7	.57	31	.89	FG105	39.98	GL530	22.95	845	8.95
12AV6	.53	HY31Z	2.75	VU111	1.45	CK531DX	1.98	849	29.95
12AV7	.58	32	1.29	NU114B	.75	531	6.90	852	19.98
12AW6	1.79	FG32/5550	13.85	MY116/545	.79	CK532DX	4.98	860	23.95
12AX4GT	1.29	32L7GT	1.49	117L/M7GT	1.89	WL532	3.98	861	23.95

864	.39	8025A	4.75						
865	1.29	9001	1.55						
866/CE1C	1.49	9002	.95						
866	1.50	9003	1.50						
872A	3.29	9006	.42						
874	1.59		.39						
878	1.98								
884/6Q5G	1.00	2AP1	9.70						
9001	2.98	3AP1	4.75						
9002	290.00	3AP1A	14.25						
9003	1.85	3BP1	6.75						
9004	1.00	3BP1A	14.98						
9005/CE2S	4.98	3CP1	4.65						
9006	1.25	3DP1	4.75						
9007	6.98	3EP1/1806P1	4.85						
9008	.98	3FP1	4.65						
9009	.39	3FP7A	14.98						
9010	.98	3HP1	7.50						
9011	.45	3HP7	3.49						
9012	1.98	3KP14	14.98						
9013	1.98	947/FG17	3.95						
9014	19.98	5DP1	5.98						
9015	16.98	5JP1	12.50						
9016	.98	5JP12	19.95						
9017	.45	4AP10	4.40						
9018	.45	4AP10	4.40						
9019	1.50	5JP1	12.41						
9020	1.45	5BP1	4.25						
9021	1.45	5CP1	4.25						
9022	.85	5CP1	4.58						
9023	.98	5DP1	13.75						
9024	9.98	5FP7	4.75						
9025	2.98	5HP1	5.70						
9026	2.98	5JP1	12.50						
9027	5.00	5JP2	19.25						
9028	52.00	5JP7	19.75						
9029	1.35	5LP1	22.25						
9030	6.98	7BP1	12.45						
9031	1.98	7BP1	10.50						
9032	.84	7BP1	8.65						
9033	.74	7EP1	8.65						
9034	2.98	7EP4	17.98						
9035	6.70	7FP7	4.39						
9036	2.69	9GP7	12.75						
9037	1.90	9JP1	4.95						
9038	.39	12DP7	16.89						
9039	.29	12DP7A	49.50						
9040	.29	12FP7	49.98						
9041	.97	12GP7	14.75						
9042	.77	12HP4	14.75						
9043	.77	12JP4	27.00						
9044	.77	12LP4	21.75						
9045	.98	9012	69.98						
9046	1.98	913	13.98						

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Model #	L	I
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Other values to specifications.

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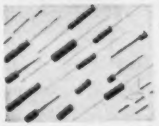

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PHC-105	690	105	5	2	6.3	3.5	6½	16.29
PHC-120	750	120	5	3	6.3	4	9½	17.23
PHC-150	740	150	5	3	6.3	4	11½	21.34
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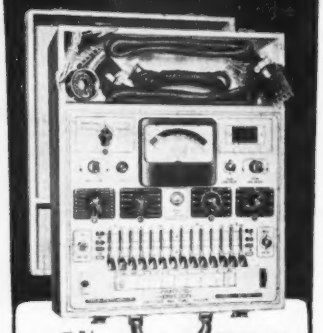

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Mgr. Television Engineering

HRS:hg

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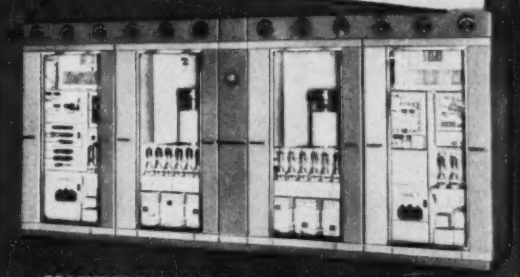

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